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SUBJECT to the approval of the council, any person interested in the improvement of the human race or the creation of better plants and animals is eligible for membership. The Secretary will be glad to correspond with those interested, and to send a copy of the magazine for examination. Annual dues, giving the right to attend the annual and other meetings, and to receive the magazine, are $2; life membership is $50. Address all communications to the Secretary.

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WIDE RANGE OF VARIATION IN DAHLIAS FROM A SINGLE PLANT

Three flowers of "Spanish Century," the color of which is regularly yellow splashed with red. The three blossoms here shown are from the same stalk. Variations like this may be due to local conditions or to some change in the germ-plasm; the only sure test of their nature is that of breeding; if they did not originate in the germ-plasm, they will not reproduce themselves. (Frontispiece.)

SOMATIC SEGREGATION

Variations in Plants May Be Divided in Two Classes, One of Which Breeds True While the Other Does Not—Modern Work Shows Importance of Former Class in Practical Breeding—Further Study May Aid in Understanding Causes of Variation in General.[1]

E. J. Kraus

State Agricultural Experiment Station, Corvallis, Oregon

HORTICULTURAL literature generally, and particularly that which deals with ornamentals, abounds in references to bud variations, bud sports or node sports according to the notion of any particular writer. Anyone dealing with plants in quantity is impressed by the differences exhibited by individuals, differences which often it would be desirable to perpetuate, if possible. It has been argued that, if vegetative propagation means simply the dividing up of an individual into many independent parts, all of which are still the same individual, then the extent to which a plant which possessed particular merit could be multiplied and disseminated, would be limited only by the relative ease of propagation. As a result, considerable work has been attempted along the lines of selection of better strains of many kinds and varieties of plants. Practically the whole idea of pedigreed nursery stock, the selection of runners in strawberries, and the reworking to another strain of unprofitable trees or orchards for greater yields or better fruit, is based on the question of bud variation and bud selection. While the evidence from most of the experiments so far conducted along these latter lines is negative, it is by no means safe to conclude that there is nothing in the idea of improvement by such methods. The greatest difficulty which has arisen and led to confusion has been the failure to recognize the difference between those unstable variations due to purely local conditions and those which, while they may be due to local conditions to some extent at least, are a real part of the plant organization and persist even under widely changed environment.

Bud or somatic variations are subject to a broad classification, much as are seminal or seed variations. Three classes are recognizable: modifications (fluctuations), segregations, and mutations. The first class is observed by far the most commonly, and has furnished the material for the larger part of the experiments which have been conducted with an attempt to determine whether superior strains could be built up and maintained entirely by the selection of vegetative parts. The second class occurs in individuals of hybrid, or supposed hybrid origin (the term being used in its broad sense), or in those individuals in which some apparently new character has arisen, but remains associated with the original form and at times exhibits itself wholly independently to a greater or less extent. To illustrate: an example of this latter sort is the manifestation of pure white in the green and white variegation of many plants, or the production of self-colored flowers by certain individuals which normally bear striped flowers. To the third class belong sudden wide changes or departures from the normal character of a plant, such as double flowers, purple foliage, certain instances of the white areas in foliage, fastigiate forms and the like, which apparently are new to that individual. It is difficult, clearly to differentiate the second and third classes, and if one believes that mutations are merely a result of hybrid

[1] Read before the twelfth annual meeting of the American Genetic Association, at Berkeley, Cal., August 5, 1915.

ancestry, class three should not be recognized. At times, even with breeding records, it would be difficult to determine whether a variation should be classed as a segregation or a true mutation; whether, in other words, the new or apparently new character became expressed through the removal of influences which suppressed or masked it, or actually arose anew.

INFLUENCE OF LOCAL CONDITIONS

As stated previously, fluctuating variation is by far the most common of all forms of variability. Such variation is greatly influenced by, and largely may be due to, environment in its broader sense. The production of inferior or superior fruit, whether it be size, color, or even quantity, may be the result of purely local conditions. A few instances of this type of variation and experiences with it are of interest.

Hedrick, in his discussion of pedigreed nursery stock, has pointed out the fact that fluctuations are not stable and, when environmental conditions are changed, characteristics change with them; and, in citing an example, states that "sixty Rome trees all propagated from buds from one branch show quite as much variation as could be found in an orchard of Romes propagated indiscriminately and growing under similar conditions." With nothing more than change of the name of the plant concerned, his statement fully summarizes a number of similar experiments.

An interesting example of range of fluctuation in size of fruit is furnished by a well-regulated Spitzenberg orchard which came under my observation. Generally the trees throughout the orchard produced average-sized fruits. Certain trees, however, consistently produced small, ill-shaped, inferior apples. Various treatments were recommended and tried but to no avail. Finally it was concluded that the trees were of an inferior strain and regrafting to a superior sort was recommended as the only remedy. Accordingly certain of the small fruited trees were severely cut back in the spring and top-worked, slightly less than one-half the number of branches being left so as not to destroy completely the balance of the tree. In the fall these remaining branches matured the finest fruits in the entire orchard; the companion trees which had not been so severely handled produced small fruit as usual. Apparently there was nothing in the idea of an inferior strain so far as these trees were concerned.

Selection for improvement in apples has been made on the basis of the color of the fruits—one of the most elusive of characters. In this regard, the following statement, which I made some time ago, since has been abundantly confirmed:

> The red in Shiawassee, McIntosh and Jonathan is composed of at least two reds, the one light and carrying with it the factor for striping, the other dark and associated with the factor for solid color. Now if these apples are grown under poor light conditions, they are almost without exception light red and striped, while in full sunlight the deep red factor further manifests itself and the fruit becomes self-colored dark red, though on close inspection the stripes are evident beneath the solid color. This is not a case of segregation; both characters are present, the one being simply overlaid by the other.

If then cions are taken from branches bearing superiorly colored fruit, due to purely local conditions, such as light, air, or moisture, the trees resulting from them when subjected to another environment might or might not prove superior, depending upon whether the new conditions were favorable to the development of the one set of colors or another. As will be brought out subsequently, however, certain color changes, the result of segregation are transmissible.

An experiment by Howard and Whitten, to determine whether the tendency toward greater yield is transmissible, is reported as follows:

> Three crops of apples have thus far been harvested from trees, part of which were grown from cions selected from high-producing parents and part from trees of low-producing parents. There was practically as much variation in yield, size, and color of fruit between trees from the same parent as there was between trees of different parentage. Bud selection from high-producing and from low-producing

A CAUSE OF FREQUENT MISTAKES

Yellow Newtown apples produced by cross-pollinating with Roxbury Russet. The upper fruit has two distinct russet bands, whose appearance is merely a coincidence, and due to the segregation of color originally possessed, not to any direct influence of the Roxbury Russet pollen. Russet is a rather uncommon segregation character in the Yellow Newtown, and it would be easy to suppose that this is a case of immediate influence of pollen were the true explanation not known. Many such erroneous conclusions have been drawn in similar cases. (Fig. 1.)

strawberries carried on through twelve previous years showed absolutely no gain in productiveness by selecting runners from high-producing parents.

More evidence and experiments of the same general nature might be adduced. The one main conclusion to be drawn from them is, that when an attempt is made to propagate a modification it is not transmitted as such alone, but its offspring are capable of developing the entire group or range of variations of which it formed a part.

Evidence and examples of segregations are abundant, and many are being recorded. From this class of variations real advance or regression may be expected. Bateson calls attention to this form of variation and offers, quite correctly, an explanation on the basis of a somatic segregation of parental characters. He cites, as one example, two Sweet-Pea vines, each of which, normally having borne heterozygous purple flowers, produced a lateral shoot which bore red flowers, showing that "the factor B has been omitted in one of the cell divisions by which they were produced." An interesting similar instance of my own observation is worth recounting. A friend who is interested in Sweet-Pea culture crossed two varieties, a pink and a white. From the second generation he secured one form which he has termed an impure dominant. It is white with pink edging, and has given rise through seed to many forms, light pinks, dark pinks, whites, a glowing salmon and a soft salmon rose, this latter being the only form which has not proven variable on further testing. Three years ago this same impure dominant produced a node-sport, a

beautiful glowing rose. Seeds from this sport produced the same rose-colored form, which has remained absolutely fixed. It is of interest to add that through seeds the impure dominant has produced similar pink forms which have not bred true.

Some three years ago Groth called attention to a seeming occurrence of 'xenia' in the peach tomato. This variety normally bears fruits which have much the appearance of very red peaches. The plants in question bore an occasional smooth fruit. Through correspondence, I later learned that experiments demonstrated certain fruits were smooth even when enclosed and protected absolutely from pollination by a smooth sort. Here again, evidently, was a case of somatic segregation, worthy of further testing. A few seeds, said to be from a fruit showing an approach to smoothness, were kindly sent me. Seven plants have resulted from the sowing of a part of the packet; six of them have a few smooth fruits, many intermediate and a few which are rough. One plant has so far produced fifty-four fruits, all very rough and pubescent. It will be of interest to determine the behavior of seedlings from the several types of fruits.

Tufts has pointed out a somatic segregation of characters in the Le Conte pear and Transcendent Crab apple, a segregation which closely approaches a simple Mendelian ratio. He ascribes this segregation to a hybrid origin of the two varieties.

VARIATIONS IN BARTLETT PEAR

A color variation of the Bartlett pear was found several years ago. It occurred as a branch on a normal tree, and differed from the normal in that the bark was a golden yellow, striped green and brown, and the fruit had prominent yellow stripes from calyx to stem. Buds from this branch have reproduced trees of two entirely distinct types. The dark form is scarcely to be told from the ordinary Bartlett; the light form is a much less vigorous grower, has golden-yellow bark tinged with pink and grows very shrubby, producing large numbers of short laterals. Normal Bartletts of the same age as the variegated trees bloomed to a limited extent last year, and profusely this year. The light form produced but two fruit clusters on a total of seven trees; the dark form had no fruit buds at all. The light form so far has not produced bloom from axillary buds on one-year wood, though normal trees have done so in abundance. This case is mentioned since it may possibly represent a case of perpetuation of a change in form, productiveness and color.

The color of fruits of apple furnishes an interesting example of segregation. By comparing with breeding records the various colors expressed in the so-called banded fruits, it was concluded that in a number of varieties there were present several factors for color; that it is possible for any color to appear pure to any extent from a small segment to the entire fruit; and that if such segregation extends to a part which may be removed and propagated vegetatively, the segregation may be perpetuated. Among the varieties of apples so propagated are Red Gravenstein, which has arisen at least twice, Red Rome, which arose three times in one orchard within the last four years, and a blood-red Spitzenberg. Many other striped or banded forms among a wide range of fruits might be listed. Attention again is called to the fact, however, that among the apples of which a study was made, no colors truly new to the variety have appeared in the somatic segregations.

As stated in the beginning, if mutations are regarded as the mere result of hybrid ancestry, then any variation which might be classed as such could be considered only as a segregation. Still there are instances of variations which do seem to be unexplainable on the basis of segregation and which certainly are not mere fluctuations. They are readily perpetuated by vegetative propagation, are decidedly distinct from the form from which they sprang, and seem to possess characters new to the individual.

The case of the green and white variegation of foliage deserves particular

consideration. It is of extremely common occurrence and generally may be observed by anyone who will spend a short time in search for it. On the campus at Corvallis there appeared on one of the several hundred bushes of Portugal laurel cultivated as an ornamental, a green and white variegation which now represents fully one-third of the entire shrub. From the green and white shoots several which are entirely white have sprung, but, as yet, none which is entirely green. The same variegation in connection with the normal plant from which it sprang, has been observed in more than a score of widely scattered species; among them red clover, maple, dandelion (Taraxacum), carnation, radish, bean, ox-eye daisy, ash, holly and Trillium. Such green and white variegations are readily propagated vegetatively. Many ornamentals also come to mind and furnish readily accessible material for study. On almost any individual it is possible to find shoots which are entirely white and frequently those which are entirely green. This behavior is clearly a case of segregation. The green shoots are readily propagated and, if left to remain on the plant from which they sprang, often outstrip the remainder of it in growth. The white form is generally vegetatively weak and usually is incapable of independent existence.

But to account for the original appearance of the "white" character. Fortunately we are in a position to know that the white exists as a recessive in some plants, as shown by Emerson in his work on maize. Chapin found, in the case of variegated Amaranthus, that seed from green branches produced green seedlings while self-fertilized seed from white branches produced white seedlings, which facts led to the conclusion that the green and white variegated plants are the result of the crossing of green and white gametes. If, then, green and white gametes exist in the case of those variegated plants (hybrids) resulting from the cross between them, the appearance of the green and the white shoots is a case of segregation resulting from hybrid ancestry. On the other hand, where the green and white forms spring directly from a form which always has been green, so far as recorded, the appearance of the white character probably would be considered as a mutation. The question arises: Is there a difference between the green and white combination which arises as a mutation and that produced by crossing green and white gametes? Whether the variegated form arises in one way or the other they are apparently indistinguishable. In either case entirely green and entirely white shoots are frequently produced in the same manner and may be similarly propagated. It is in instances of this kind that the line of demarcation between segregations and mutations is drawn only with greatest uncertainty. A further study of them may aid us also in arriving at a more definite knowledge of the nature of mutations themselves.

Double flowers from single flowers, laciniated foliage, weeping and fastigiate forms, purple foliage, and other less common variations are considered as mutations. It seems that, in general, many wide changes in the color of the flower should be classed as a segregation rather than a mutation, especially so if breeding records show the same colors among the progeny, though, even under these circumstances, how to distinguish the two absolutely is a problem, since it may be argued that the appearance of new colors among the seminal offspring may likewise be due to mutation.

Like true segregates, mutants may be perpetuated vegetatively, and scores of horticultural varieties exist. The exceptions to this rule are the pure white forms which soon perish when severed from the parent plant and may be budded or grafted into other stocks only with greatest difficulty.

SUMMARY

To sum up, then, vegetative variations are first of all of two distinct sorts—modifications or fluctuations, which do not remain true when propagated and subjected to varying conditions, and segregations or mutations which may be propagated and expected to remain reasonably constant under a

wide range of conditions. In the past experiments have largely dealt with modifications, and the conclusion reached that little or no advance could be expected from the selection of vegetative variations. There is certainly good evidence accumulating, as the work of Shamel shows, that among citrus fruits, at least, distinct advance is being made in plant improvement through bud selection alone. This is no doubt a case in which true segregates or mutants have been utilized and, if so, they can be expected to remain constant under a wide range of conditions. There is a broad field for work on the genetics of bud-variations, and when their nature is better understood and the lines of discrimination more clearly drawn between the several classes, more rapid advance in their utilization may be expected. It seems likely that many of the laws pertaining to the perpetuation of fluctuations among seminally propagated pure lines will apply with equal force to vegetative fluctuations in a clonal variety. If so, a study of the one may well be taken into consideration in connection with a study of the other in any attempt to arrive at the fundamentals underlying either. And, as suggested previously, it seems entirely possible that a closer study of the cases of vegative segregations and mutations, as they come to hand, will aid materially in the advancement of knowledge concerning the nature of variation in general and the discovery of the principles underlying it.

Alaskan Berry Hybrids

At the Sitka Experiment Station in Alaska a strain of hardy strawberries is in the making, the result of crosses between the native of the Alaskan coast region and cultivated varieties. Several thousand seedlings have been grown, all very vigorous and most of them productive and of high quality. The native variety of the interior of Alaska is now to be used in similar crosses.

The Cuthbert raspberry has been crossed with its relatives the native Salmonberry (*Rubus spectabilis* Pursh.) and the Thimbleberry (*R. parviflorus* Nutt.). The only interesting fact so far developed is that the hybrids of the two species first named are almost entirely sterile.

Report of Committee on Nomenclature

In order to determine whether any one of the three nouns, *geneticist*, *genetist*, and *genetician*, should be adopted to designate students of genetics, the undersigned committee on nomenclature of the American Genetic Association has got the opinion of a dozen of the leading philologists of the country. It finds that the form *geneticist*, which is most widely current, is favored by most of the philologists as being formed in accordance with the best usage. The form *genetist*, which has some currency, gets very little support from good etymological usage. The term *genetician*, although a hybrid, can be supported by abundant analogy; it has however, little or no currency at present.

Under these circumstances, the members of this committee unanimously intend to adhere to the form *geneticist* for their own personal use; it will also be used in all official communications of this association.

The committee realizes that usage cannot be arbitrarily established by fiat. Believing, however, that uniformity in this matter is desirable, it takes this opportunity to call the attention of all who are concerned with genetics to the fact that the term *geneticist* is worthy of general adoption, in the interests of uniformity and correct etymological practice.

(Signed) Herbert J. Webber, R. Ruggles Gates, George H. Shull, W. E. Castle, Raymond Pearl, Paul Popenoe.

HEREDITY AND SEX

Many Live-Stock Breeders Believe Disproportionate Sex-Ratios May Be Due to Inheritance—Experimental Breeding of Dr. Helen Dean King at Wistar Institute Indicates that Such is the Fact in Two Strains of Rats

UNDER ordinary conditions, for every 100 female calves born in a herd of cattle, there will be 107 male calves, the sex ratio being approximately the same as that of the human species.

To a breeder of dairy cattle it is obvious that an increase in the proportion of heifers produced would be highly advantageous. On the other hand, a large increase in the number of bulls born might be disastrous.

Miss Jessie C. Kursheedt, of New York, one of the members of this association, is interested in a herd of registered dairy cattle where about 75% of all the calves born in recent years have been bulls. She was led to think that this unfortunate state of affairs might be due to something in the heredity of the herd sire, and accordingly investigated his pedigree from that viewpoint.

It was found that he had at least two lines of ancestry in which disproportionately large number of male calves had been produced. His own sire was shown in the herd book to have fathered sixteen bulls and seven cows; while the sire's sire had seventeen bulls and thirteen cows to his credit. The herd sire's grandsire on the maternal side was found from the breed records to have sired twenty-three bulls and seventeen heifers.

While the numbers are small, and the herd book records not likely to be very accurate on this point, it can at least be said that in this pedigree a general tendency is shown to produce more offspring of one sex than of the other.

Practical breeders have often suspected that such a condition might exist. *Hoard's Dairyman* (June 25, 1915), contains the following letter from Herb. E. Sharp of the State of Washington:

"I have developed a strain of Langshan fowls that are producing over 90% females, and the trait is being transmitted from generation to generation.

"The earliest records we have of this trait were of a hen that produced about 60% females. She was accidentally bred in such a manner that the trait gradually became stronger until in the seventh generation we have hens producing from 90% to 97% females.

OTHER CASES IN CATTLE

"Have found one family of dairy cattle containing one world's record cow and her two sisters that have dropped twelve male calves and only one female. An examination of the records of the daughters of their sire, by other cows, shows that they too have inherited the trait, and are producing from 75% to 90% males.

"The males of this family, when used as herd sires, have transmitted this tendency along with other characteristics of the family, so that a preponderance of males is quite noticeable among the offspring of several herds of high quality stock.

"Certainly no man can long remain in the dairy business with a herd of cows whose calves are all bulls; a sire's value must depend entirely upon what his daughters produce in milk, butter, and calves; and the sire, whose daughters drop nothing but male calves, no matter what their milk and butter records may be, will put his owner out of business or compel him to buy a complete new herd of cows in a few years."

"In 1912, I mated twelve hens to one cock bird. He was very vigorous, and as he had the entire liberty of the yard where they were all confined, we can safely presume that he would find practically all the hens

when they first came into the season. Now if there were anything at all in the theory advanced that the time of mating controls the sex of the offspring, a large proportion of these females must have performed in a nearly uniform manner, as all were under practically identical conditions or as nearly as possible to secure.

"There were not two hens that performed in an identical manner, and there was not even an approximate uniformity in their performances. One hen produced all males, another produced all females, and the rest, each seemed to take her own course in various degrees between these two extremes; some of the hens were mated again to the same male, and some to other males the following year, while some were discarded.

"All those retained in the breeding pens the next year, regardless of the influence of the various males, repeated their former year's work with some very slight variations. The hen that raised all females, after three years' work, finally raised one cockerel, but he came after she had produced sixty pullets.

"Five of her daughters were then tested and produced seventy-five pullets and two cockerels. In this family the sex tendency is strong enough to be transmitted, and in any family the individual that is strong enough to transmit his sex tendencies, certainly has greater power to transmit than the individual that cannot transmit sex tendencies and as a sire's value depends on what he transmits, then the sire that transmits sex tendencies, especially a tendency to a predominating number of females, is of vastly greater value than the sire without this power or with a tendency towards a predominating number of males.

"Some one said: 'Your bull may be losing $6,000 a year for you,' but I know a whole family of bulls that carry world's record blood in their veins that are putting their owners out of the dairy business at a rapid rate, not even suspected by their owners, and these bulls sold for over a thousand dollars each."

The editor of *Hoard's Dairyman* properly comments on this letter, that the amount of time through which Mr. Sharp's breeding experiments have been carried is not enough to furnish conclusive proof. A breeding experiment well known to geneticists has been carried on for six years under the most careful conditions, however, and has given results which lend some color to the belief that one may get a strain of animals that has a tendency to produce disproportionate numbers of one sex.

This is the inbreeding experiment of Dr. Helen Dean King at the Wistar Institute, Philadelphia, in which more than 22,000 albino rats have been bred and studied. Although Dr. King has not yet published her results, it is possible here to state the general trend of the experiment.

In the rat, the normal sex ratio happens to be the same as in man and cattle; namely, 107 males to 100 females. Dr. King began her work by taking from the stock animals one healthy litter of new-born rats, two males and two females. The descendants of one pair of the rats have, after the sixth generation, all come from the mating of brother and sister from litters in which males invariably predominated. This is the A or male line. The B or female line of her experiment came from the other pair of the original litter and has been obtained by mating brothers and sisters from litters containing (after the sixth generation) an excess of females. In the first six generations no selection for sex was made, the object being to get the stock well-established and homogeneous.

All of the 22,000 rats used are therefore descendants of one or other of the two pairs in the litter first picked out for the foundation of the experiment, and in the two strains there has been, since the sixth generation, steady selection in the opposite directions, through twenty-one generations, with strict inbreeding of the animals selected.

By this process, the tendency to produce a disproportionate number of one sex appears to have been fixed in

each line of descent. The result is, that instead of a normal ratio of 107 to 100 (which was established for this particular stock at the beginning of the experiment, by ascertaining the sex ratio in 1,000 newborn litters), Dr. King now gets in various generations ratios as far apart as 150 males to 100 females, in the male producing line, and sixty-five males to 100 females, in the female producing line.[1]

If such a state of affairs can be reached under the carefully controlled conditions of a laboratory, it is not a rash assumption to suppose that it might occasionally be reached unknowingly in the herd of a practical breeder.

IN LIVESTOCK INDUSTRY

Whether such conditions actually prevail in the livestock industry cannot definitely be told except after thorough examination of the records of that industry. This would offer numerous difficulties. In the meantime, with the analogy of Dr. King's experiments on rats, any breeder whose herd sire is producing mainly bull calves, and who finds that such a tendency marks the ancestry of the animal in question, might well feel justified in getting a new herd sire with a more auspicious record.

Finally, can such a peculiar sort of heredity as Dr. King has found, be brought into line with what is at present known or suspected regarding sex-determination?

There are numerous ways in which it can be explained, without resorting to anything mystical. Dr. King has not yet attempted to offer a definite explanation, but suggests that it may be due to such a simple cause as differences in the permeability of the eggs. It will be recalled that there are probably two kinds of spermatozoa in the rat, one of which is male-producing and the other female-producing. As these are apparently produced in equal numbers, it is evident that, since there is seemingly only one kind of ovum, the number of young of each sex produced would of necessity be equal, unless some outside cause intervenes.

It is further evident that if the eggs of a given female were, for some reason, more easily penetrated by male-producing than by female-producing sperms then that female would tend to produce an excess of male offspring. If the condition were reversed, she would produce an excess of females.

It requires no strain of the imagination to suppose that a race of rats might be developed, in which there was a hereditary tendency in the eggs to be penetrated more easily by one kind of spermatozoa than by the other. If so, the sex-ratios which have resulted from Dr. King's breeding experiments would be easily explained.

Whether that is the actual explanation in this case, and whether some similar explanation also applies to the cases which seem to have been found in cattle and fowls, one cannot now say. But regardless of explanation, the observed facts seem reasonably certain, namely, that it is possible for a tendency to produce disproportionate numbers of one sex of offspring to be hereditary in rats, and perhaps in other animals.

[1] Dr. King notes that she "cannot in any case predict the sex ratio in an individual litter, since not infrequently the two litters of one female will each contain an excess of males while the litters of a sister rat, mated to the same brother, will both contain an excess of females. It is only when we take averages for a large number of individuals that we get the results as indicated. The average sex ratio for the entire A series is 125 males to 100 females; that for the B series is only eighty-three males to 100 females." The deviation from the usual ratio has been in the same direction, in each line, in every generation except one. The tenth in the A line and the seventh in the B line are the exceptions.

TWO PHEASANT CROSSES

Reciprocal Matings Give Widely Different Results in Female and Identical Results in Male Offspring—Females Practically Sexless—Possibility of Sex-Linkage as Explanation

John C. Phillips, *Wenham, Mass.*

In the *American Naturalist* for 1913 (p. 701), the writer described a reciprocal first cross between Reeves' pheasant and the common ring-neck pheasant (*P. torquatus*). It was shown that the males differed very perceptibly in the two crosses, but of the females nothing could be learned because only one female was reared from the cross of male ring-neck female Reeves, and none at all in the other cross.

In order to find out whether these sterile reciprocal hybrids *always* differed in the male sex, and also whether the females would show any differences, another cross was carried out in 1914 as a check upon the first experiment. But in the second experiment the Prince of Wales pheasant (*P. principalis*) was used instead of the *P. torquatus*.

The *P. principalis*, a distinct species of true pheasant, belongs to the dark-necked, red-rumped group, and has been used in another cross by me. (See Jour. Exp. Zool., Vol. 18, p. 93.) The striking features of the male are briefly as follows: neck-ring absent, lesser and median wing coverts white, with white shaft stripes on greater coverts; rump and upper tail coverts orange red, with a few fine black dots; tail barring reduced to faint lines. On the other hand, *P. torquatus* differs markedly in these four points, as follows: white neck-ring well marked; rump greenish to greenish slate, with subterminal bars of brilliant green; lesser and median wing coverts mostly sandy-buff color; tail barring very marked, especially towards the tip, where black areas 6 to 12 millimeters wide occur. There are other differences which need not be mentioned here The female of *P. principalis* is much lighter colored than the *torquatus* female, but otherwise very similar, and the two species produce fertile hybrids.

REEVES PHEASANT

The Reeves pheasant, *Syrmaticus reevesi*, a familiar aviary species, is a wholly different looking bird, and belongs to a monotypic genus. The male is entirely unlike any of the true pheasants (*Phasianus*) in coloring, and has a tail 3 or 4 feet long. The upper surface of the body is bright golden color, with black edgings to the feathers of the mantle, back and rump, while the breast and flanks are barred with white, black, and chestnut. The head is strikingly marked with black and white. The female Reeves pheasant is also unlike any true pheasant, and shows some of the male characters in her face pattern and the colors of her mantle, breast, and flanks.

In this cross, therefore, we have to do with two species, not only different in the male sex but wholly unlike in both sexes and in all plumages, and always producing absolutely sterile hybrids.

In 1914, a Reeves cock was mated with two Prince of Wales females (Pen J 1914), and a Prince of Wales cock was placed with a couple of Reeves females (Pen K 1914). It may be remarked that both these parent stocks were inbred and came from the same grandparents. Large numbers of *P. principalis* have been reared here and no variations noticed.

From Pen J nine birds were reared to maturity, four males and five females, and from Pen K, one male and three females. A wandering cat somewhat curtailed the experiment.

Comparing the two pens of males and the two pens of females, we get the fol-

DIFFERENCES IN SIZE OF HYBRID PHEASANTS

The small skeleton (*a*) at the left is that of a female from the cross of a Reeves male pheasant and Prince of Wales female; while in the middle (*b*) is the female of the reciprocal cross, namely, Prince of Wales male and Reeves female. It is obvious that the latter cross produces a much larger bird, though the parentage in each case is the same except in the matter of sex. At the right (*c*) is a male from either cross, the results being practically identical in that sex. (Fig. 2.)

lowing result: Males from J and K alike, as far as can be determined, but females from J differ from those in K in size and color. To explain more fully let us take up these three points:

Size.—The five J females are uniformly small. They feathered late and were always lacking in flesh and vigor. The skeleton is extremely light (see fig. 2, A), and smaller in every dimension than its fellow of the opposite cross (fig. 2, B). Their tails are short and Reeves-like. They are also much smaller than other Reeves or principalis females.

THE RECIPROCAL CROSS

The three K females, on the other hand, are large heavy birds with long tails, male-like actions, and in two cases well-developed spurs. The plate shows them to be nearly as large as the male birds and with tails fully as long. The individual whose skeleton is figured did have spurs (fig. 2, B). They are far larger than the females of either of the parent species.

Plumage.—The color differences are fully as remarkable as those of size. The J females are all alike or very nearly so, and extremely similar to Reeves females. The photograph of the skins shows well the barred appearance of breast and flanks, the chestnut mantle and the greyish back and rump.

On the other hand, the K females are extremely male-like, especially in the markings about the head which in No. 1543 are even more sharply contrasted than in the specimen shown in the plate (No. 1542). They are, essentially, washed-out, coffee-colored imitations of their brother hybrids and were supposed to be males until they were dissected. They differ a little, individually, in the intensity of their coloration, and in the development of the male face pattern. The most extreme, or most Reeves-like,

PLUMAGE DIFFERENCES IN RECIPROCAL CROSSES

In the center are males from the two crosses, which are as much alike as one would expect to find two brothers. At the sides are the females from the same two crosses—here we at once see wide contrasts, in practically every point examined. (*a*) is female hybrid from the cross of male Reeves pheasant with female Prince of Wales; (*b*) is male hybrid from the same cross; (*c*) is male hybrid from the cross of male Prince of Wales and female Reeves, while (*d*) represents the female hybrid from the cross of Prince of Wales male and Reeves female. (Fig. 3.)

VENTRAL VIEWS OF THE HYBRIDS

The same birds photographed in fig. 3 are here shown, turned over. The males are seen to be as much alike below as above, while the differences between the females are even more striking in this aspect. Arrangement of birds is the same as in the preceding cut, as follows: (*a*) female hybrid from cross of Reeves male and Prince of Wales female; (*b*) male hybrid from the same cross; (*c*) male hybrid from cross of male Prince of Wales and female Reeves; (*d*) female hybrid from the latter cross. (Fig. 4.)

No. 1543, has a black patch on the throat and another on the nape, while the auriculars are blackish and the intermediate region of face and neck white or buffy. The tails are all barred, but not coarsely, while the narrow black streaks on the rump show well the pattern of the principalis male. These birds, therefore, show very little influence of the Reeves female. Comparing them with our one female specimen from male ring-neck x female Reeves, the corresponding cross made in 1912, they appear entirely different. This female (No. 448) has no trace of male plumage. She corresponds very closely to the J females of 1914, but she is much larger than any of them.

FEMALES ARE SEXLESS

Sex Glands.—Perhaps the greatest surprise of all was the failure to find any trace of germinal tissue in any of the females of either cross. All suspicious tissue from the proper region was fixed and sectioned, but the results have been entirely negative. These sexless birds are called females on the strength of a small and flaccid oviduct, normally placed and present in all cases.

Turning to the males, I find that there is no trace of a reciprocal difference as occurred in the Reeves x ring-neck cross of 1912. Both crosses are darker in color than the darkest cross of 1912 (male ring-neck x female Reeves). This fact may be explained by the generally darker tone of Prince of Wales males as compared with ring-neck males. The tails are always barred, unlike the male Reeves x female ring-neck cross of 1912. The ground color of the central tail feathers is darker than that of the 1912 cross and the backs, scapulars and rumps are more uniform. No other differences are apparent, the presence or absence of neck-ring having no apparent effect on the pattern of the hybrids.

All the males of the 1912 and of the 1914 crosses are similar in size. The reciprocal difference of male plumage described for the 1912 cross is trifling as compared with the wide size and pattern differences in the females of the 1914 cross.

Summary.—In the 1914 cross, Reeves male x Prince of Wales female (cross J) and in the reciprocal cross Prince of Wales male x Reeves female (cross K), the sterile male hybrids are similar and closely approximate the slightly different reciprocal hybrids of the Reeves x ring-neck experiment of 1912. With the females, however, of the two first-mentioned crosses, there are almost no points in common. In cross J they are shown to be small, female-like, and very close to the Reeves female in their coloring. In cross K they are large and male-like, with pattern and coloring of both the male parents. No trace of a sex gland was found in any of these females, but a small and thin-walled oviduct was always present.

These facts are simply given for what they are worth. The writer does not feel competent to enter into a discussion of their possible significance. It is possible that they may be explained on the basis of sex linkage, with the assumption that the eggs are dimorphic and the sperms monomorphic for sex and sex linked characters, but no proof is available on account of the impossibility of testing the sterile hybrids.

The most suggestive point about these hybrids seems to the writer to be the Reeves-like appearance and puny size of the females when the male Reeves was used as a parent. It would almost seem as if gametes bearing Prince of Wales characters had been kept apart in producing these females. Their extremely small size led to a question as to the size of their somatic cells. Rough measurements of their spleen cells made for me by D. H. Wenrich failed to reveal any difference of this sort between K and J females. Obviously the chromosome count would be of great interest in this case also. The absence of ovarian tissue is another curious feature which demands further experiment to verify completely.

MENDELISM UP TO DATE

A REVIEW

IT IS just half a century since the Austrian monk, Gregor Mendel, published in a provincial journal the results of his now famous breeding experiments with garden peas. They lay unnoticed until 1900, when three other breeders whose work had led them to similar conclusions, almost simultaneously turned up the work of Mendel and gave it to the world.

Breeding along the lines marked out by Mendel at once became the most popular method of attack, among those who were studying heredity. It is largely responsible for the creation of a new science—genetics.

During the past fifteen years, hundreds of thousands of plants and animals have been bred under carefully controlled conditions by men interested in repeating and extending Mendel's conclusions. The publications on the subject are for the most part brief, widely scattered, and almost meaningless to one who is not in the current of Mendelian research. This has prevented many persons from appreciating the progress of that research in its broad outlines. The present status of it is now set forth by Professor T. H. Morgan of Columbia University, and three of his associates,[1] under the title of "The Mechanism of Mendelian Heredity," their account being based principally on their own work.

Professor Morgan fears that zoologists and botanists are tending to look on genetics as a field apart, with which they have no direct concern. He believes that this is a mistaken attitude; that every biologist needs a knowledge of genetics; and it is to provide the members of the profession with a succinct account of what they need to know about this science, he says, that he and his students have written the present book.

One of the useful functions of the volume should be to bring home to readers who have a little knowledge of genetics a realization of the fact that the term "Mendelism" is nowadays used to cover a number of distinct and, in their details, often irreconcilable views. Professor Morgan's Mendelism would hardly be acknowledged as such by many who think themselves Mendelists; and other students have advanced speculatively in certain directions even farther from the base than he has.

PROGRESS IN MENDELISM

To put the matter very frankly, we will have to consider that a large part of the so-called "Mendelism" which is current at present is in some way out of date. This is perhaps particularly true of the views held by the rank and file of eugenists, who are obliged to work with a material that is in many ways unsuitable for genetic analysis, and whose exposition of Mendelian heredity rarely fails to provoke a smile of pity from the advanced student in the subject. A considerable part of the students of genetics are, judged by the present book, behind the times, and working with hypotheses that, according to the authors, will not stand in the light of some of the recent laboratory work. The cause of this state of affairs is undoubtedly due mainly to the fact that it has been impossible for students to get a comprehensive account of recent developments in the science; they were seeking for light, but none was given them.

It is likely, then, that they will welcome the illumination of Dr. Morgan and his co-authors.

Before we analyze their views, however, let us try to get clearly in mind the fundamentals of that type of heredity known as Mendelian.

[1] The Mechanism of Mendelian Heredity, by T. H. Morgan, Professor of Experimental Zoology, Columbia University; A. H. Sturtevant, Cutting Fellow, Columbia University; H. J. Muller, Assistant in Zoology, Columbia University; C. B. Bridges, Fellow in Zoology, Columbia University. Pp. xiii+256, figs. 64; bibliography. New York, 1915, Henry Holt and Company.

Inherited differences in individuals, it will be admitted, are due to differences in their germ plasms. It is convenient to think of these differences in germ plasms (that is, differences in heredity) as being due to the presence in the germ plasm of certain hypothetical units, which are usually referred to as *factors*. The factor, nowadays, is the ultimate unit of Mendelian research.

Each of these factors is considered to be nearly or quite *constant*,—that is, it undergoes little, if any, change from generation to generation. It is not "contaminated" by other factors with which it may come in contact in the cell. This is the idea which gives rise to the phrase "purity of the germ cells."

The first fundamental principle of Mendelism, then, is the existence of relatively constant units, the Mendelian unit-factors, as the basis for transmission of all the traits that go to make up an animal or plant.

ALLELOMORPHISM

From experimental breeding we find reason to believe that each factor has one or more alternatives, which may take its place in the mechanism of heredity, thereby changing the visible character of the individual plant or animal in which it occurs. To put the matter a little differently, one germ cell differs from another in having alternatives present in place of some of the factors of the latter. A given germ cell can never have more than one of the possible alternatives of each factor.

These alternatives of a factor are called its allelomorphs.

Now a mature germ cell has a single system of these factors; but when two germ cells unite, there result from that union two kinds of cells—namely, immature germ cells and body cells; and both these kinds of cells contain a double system of factors, because of course they have received a single entire system from each parent. This is the second of the fundamental principles of Mendelism: that the factors are single in the mature germ cell, but in duplicate in the body cell (and also in the immature germ cell).

In every cell with a double system of factors, there are necessarily present two representatives from each set of allelomorphs, but these may or may not be alike—or in technical language the individual may be homozygous, or heterozygous, as regards the given set of alternative factors. Looking at it from another angle, we see a *single* visible character in the plant or animal, but it is produced by a *double* factor in the germ plasm.

When the immature germ cell, with its double system of factors, matures, it throws out half the factors, retaining only a single system; and the allelomorphic factors which then segregate into different cells are, as has been said above, uninfluenced by their stay together.

But the allelomorphic factors are not the only ones which are segregated into different germ cells, at this maturation of the cell; for the factors which are not alternative are likewise distributed, more or less independently of each other, so that it is largely a matter of chance whether factors which enter a cross in the same germ cell, segregate into the same germ cell or different ones, in the next generation. This is the next fundamental principle of Mendelism, usually comprehended under the term "segregation," although, as has been pointed out, it is really a double process, the segregation of alternative factors being a different thing from the segregation of non-alternative factors.

From this fact of segregation, it follows that as many kinds of germ cells can be formed by an individual, as there are possible combinations of factors, on taking one alternative from each pair of allelomorphs present. In practice, this means that the possible number of different germ cells is almost infinitely great, as would perhaps be suspected by anyone who has tried to find two living things that are just alike.

THE ESSENCE OF MENDELISM

Such is the essence of Mendelism; and the reader is probably ready to admit that it is not a simple matter, even when reduced to the simplest terms. To sum up, the principal fea-

tures at the base of the hypothetical structure are these:

1. There exist relatively constant units in the germ plasm.

2. There are two very distinct relationships which these units may show to each other. Two (or more) unit factors may be alternatives in the mechanism of inheritance, indicating that one is a variation (or loss) of the other; or they may be independent of each other in the mechanism of inheritance.

3. The mature germ cell contains a single system of independent factors (one representative from each set of alternates).

The immature germ cells, and body cells, have double systems of independent factors (two from each set of alternatives).

4. The double system arises simply from the union of two single systems (*i. e.*, two germ cells), without union or even contamination of the factors involved.

In the formation of a single system (mature germ cells) from a double (immature germ cells), pairs of alternates separate, passing into different germ cells. Factors not alternates may or may not separate—the distribution is largely a matter of chance. This chance distribution is more or less disturbed by the phenomenon of linkage, which will be described later in this review.

INFLUENCE OF WEISMANN

Such are the fundamental principles of Mendelism; but on them was early grafted a theoretical structure due mainly to the German zoologist, August Weismann. To understand his part in the story, we must advert to that much-mooted and too often misunderstood problem furnished by the *chromosomes*.

These little rods of easily stained material, which are found in every cell of the body, were picked out by Weismann as the probable carriers of heredity. With remarkable acuteness, he predicted their behavior at cell-division, the intricate nature of which is usually the despair of every beginner in biology. When Mendelian breeding, in the early years of this century, showed temporary pairing and subsequent separation of units in the germ cell, it was soon realized that the observed facts of breeding fitted to a nicety the observed facts (predicted by Weismann) of chromosome-behavior; for at each cell-division the chromosomes, too, pair and separate again. The observed behavior of transmitted characters in animals and plants followed, in so many cases, the observed behavior of the chromosomes, that many students found it almost impossible to believe that there was no connection between the two, and Weismann's prediction, that the chromosomes are the carriers of heredity, came to be looked on as a fact, by many biologists.

But when this much of Weismann's system was accepted, other parts of it went along, including a hypothetical system of "determiners" in the chromosome, which were believed to determine the development of characters in the organism. Every trait of an animal or plant, it was supposed, must be represented in the germ-plasm by its own determiner; one trait, one determiner. Did we find a notch in the ear running through a pedigree? Then it must be due to a determiner for a notch in the ear in the germ-plasm. Did we find mathematical ability hereditary? Then there must be a determiner, the expression of which was mathematical ability.

For a while, this hypothesis was of service in the development of genetics; some students even began to forget that it was a hypothesis, and to talk as if it were a fact. But the exhaustive tests of experimental breeding of plants and animals have long caused most of the advanced students of genetics to drop this simple hypothesis.

In its place, we have the *factorial hypothesis*, evolved by workers in America, England, and France at about the same time, and of which the work of Morgan and his associates at Columbia University is one of the solid bases. It is the hypothesis accepted by a majority of the leading American geneticists at the present day; unfortunately it is scarcely apprehended by many who are not actively working in genetics, and

a few who are. Eugenists, for example, almost to a man have failed to adopt this hypothesis.

FACTORS ARE NUMEROUS

They tend to cling to the old Weismannian idea of one determiner for each visible "unit character." Morgan and most of the advanced students of the subject declare flatly that such an idea is, in the light of recent research, absolutely untenable. In place of it they have adopted the hypothesis that each visible character is due to the cooperation of an indefinitely large number of factors in the germ-plasm; and conversely, that each single one of these factors produces an influence on an indefinitely large number of traits.

It is of the utmost importance that this hypothesis should be understood, for it is the basis of a large part of the work in genetics today. Those who accept it must give up talking about, *e. g.*, Roman nose being due to a determiner for Roman nose in the germ-plasm. The modern view would say that the "Romanness" of the nose is due to the interaction of a very large number of factors, each of which, in turn, is also probably influencing an indefinitely large number of other characters in the body.

This is not a mere speculative hypothesis—the authors look on it as almost a demonstrated fact. For example, the little pomace fly, Drosophila, which they have been breeding in immense numbers, has normally a red eye. At an earlier day it would have been assumed that it possessed some determiner which caused the color of the eyes to be red. But in the course of the breeding, as many as twenty-five distinct mutations in this eye color have come to light. It is, therefore, their assumption that at least twenty-five different factors are concerned in the production of this red eye color, and that when a single one of these factors changes, a different end result is produced, such as pink eyes, or vermilion eyes, or white eyes, or eosin eyes.

"Each such color may be the product of twenty-five factors (probably of many more) and each set of twenty-five or more differs from the normal in a different factor. It is this one different factor that we regard as the 'unit factor' for this particular effect, but obviously it is only one of the twenty-five unit factors that are producing the effect. However, since it is only this one factor and not all twenty-five which causes the difference between this particular eye color and the normal, we get simple Mendelian segregation in respect to this difference. In this sense we may say that a particular factor (p) is the cause of pink, for we use cause here in the sense in which science always uses this expression, namely, to mean that a particular system differs from another system only in one special factor.

EFFECT OF ONE FACTOR

"The converse relation is also true, namely, that a single factor may affect more than one character. For example, the factor for rudimentary wings in Drosophila affects not only the wings, but the legs, the number of eggs laid, the viability, etc. Indeed, in his definition of mutation, De Vries supposed that a change in a unit factor involves all parts of the body. The germ-cells may be thought of as a mixture of many chemical substances, some of them more closely related to the production of a special character, color, for example, than are others. If any one of the substances undergoes a change, however slight, the end product of the activity of the germ-cell may be different. All sorts of characters might be affected by the change, but certain parts might be more conspicuously changed than are others. It is these more obvious effects that we seize upon and call 'unit characters.' It is the custom of most writers to speak of the most affected part as a 'unit character,' and to disregard minor or less obvious changes in other parts. They frequently speak of a unit character as the result of a unit factor, forgetting that the unit character may be only one effect of the factor."

It is hardly necessary to insist on the far-reaching practical importance of this changed viewpoint. Nor is it necessary to insist on the slight degree to which it has so far been apprehended

by the public, for a glance over the great body of semi-popular writings on genetics, particularly as concerned with man, will show that the primitive and charmingly simple idea of "one character, one determiner" still prevails.[2]

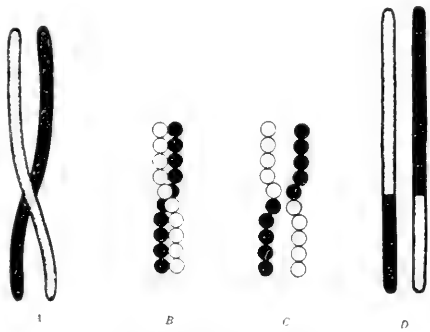
In addition to this fundamental revision of the hypothesis by which the observed facts of Mendelian heredity are explained, we have some extensions that are of great importance. The first to be considered here is connected with the now widely-accepted hypothesis that the chromosomes furnish the basis for Mendelian heredity.

With the adoption of this hypothesis, it was obvious from the beginning, as the authors point out, "that there was one essential requirement of the chromosome view [of heredity], namely, that all the factors carried by the *same* chromosome should tend to remain together. Therefore, since the number of heritable characters may be large in comparison with the number of pairs of chromosomes, we should expect actually to find not only the independent behavior of pairs, but also cases in which characters are linked together in groups in their inheritance. Even in species where a limited number of Mendelian units are known, we should still expect to find some of them in groups."

LINKAGE OF FACTORS

Bateson and Punnett, in 1906, made the discovery which according to Morgan meets this need; the phenomenon is now called *linkage*. Its importance in the theory can be understood from the fact that in the fruit-fly (Drosophila), the principal material for work at Columbia University, more than a hundred separate factors have been studied in heredity, and they have been found to be linked together in only four systems (corresponding to the four chromosomes of the fly), one of which contains, so far as is now known, but two factors.

After it was found that factors were linked together the question naturally arose, Do they always remain linked, or do they sometimes break away and form new combinations? Experimental breeding has shown that the latter is the case. Another item is therefore added to the outline of Mendelism: *crossing over*, in which a character leaves the group to which it is normally linked, and unites with the alternative group. This behavior can be plausibly explained through the chromosome mechanism; for at one period in their history the chromosomes unite and then split. It is evident that a crossing over of various factors might be quite possible at this time.



CROSSING OVER

Diagram representing the way factors may cross from one chromosome to another. At the level where the black and white rod cross at (*a*) they fuse and unite separating as shown in (*d*). The details of the crossover are shown in (*b*) and (*c*). From Morgan et al. (Fig. 5.)

Starting with this fact of crossing over the authors reached another conception, which is one of the newest developments in heredity and which seems to give us such a precise knowledge of this phase of inheritance that many workers contemplate it aghast, holding their breaths and hardly daring to believe that we can have traveled so far in the exploration of a territory that was not long ago thought pathless. This conception which has been lately introduced by Morgan and his associates is that of the *linear arrangement* of factors.

[2] It is worth noting that a large part of the attacks on Mendelism are based on this older interpretation of it. When critics prove to their own satisfaction, in many pages of evidence, that the idea of "one character, one determiner," which they consider to be Mendelian, is perfectly monstrous, the advanced Mendelist merely smiles and agrees with them. The factorial hypothesis is untouched by most of the shots at "Mendelism" in general.

The curious and definite facts which have led to this conception must be dealt with in explaining heredity by any hypothesis, but seem to fall in exactly with the chromosome hypothesis which is adopted by the authors. We start with the idea that the factors are carried in the chromosomes, and that from time to time they cross over from one to another, after the manner diagramatically shown in Fig. 5. When the relative frequency of the occurrence of the various possible crossovers was tabulated it was found that they were made with a certain regularity, which was hardly compatible with the idea that the factors were swimming around at large in the chromosome, or that they changed places without any provocation. It was found almost necessary to assume that they had definite stations, that each factor was regularly located at a certain definite point in the chromosome.

PROOF OF LINEAR ARRANGEMENT

That assumption is exactly what the authors have made; and, as they have had a great number of cases of crossing over to study, they have been able actually to draw a map of the four chromosomes possessed by Drosophila, and to locate in them the various traits which they have studied. The correctness of their map can be tested in a very ingenious way:

"The chance that such a process of crossing over will occur between any two given points on the chromosome should obviously be greater, the greater the distance between these points. If then the Mendelian factors lie along the chromosome, the amount of crossing over between any two of them will depend on their distance apart. Should two points lie near together a crossover will only rarely occur between them; if they lie further apart the chance of such a crossover taking place at some point between them will be greater. From this point of view the percentage of crossing over is the expression of the 'distance' of the factors from each other."

In other words, this is a case where we can ask, and receive, definite mathematical evidence to support the idea of linear arrangement. We need only examine the behavior of a group of factors that are not too far apart. If we find that factors A and B are crossing over four times in a hundred opportunities, while factors B and C are giving twelve crossovers in the same number of chances, then we should expect to find that the number of crosses of A and C is either the sum or the difference of these two numbers—*i. e.*, sixteen or eight—depending on whether C lies to the one side or the other of A and B. Having ascertained the relative position of C, we then go on to D, E, and all the other factors that we find in the group, and which are fairly close together—for if they are far apart, the crossing over will be disturbed, for reasons that need not be described here. The authors say that they have actually got the definite numerical results expected, and these have enabled them to draw the chromosome map which they print as a frontispiece.

The idea of linear arrangement of the factors, it should be added, depends at present almost wholly on the work of the authors, few other geneticists having suitable material for testing it. The authors have shown that it fits some of the results obtained by Bateson and his associates, which were explained by those experimenters on a different basis.

It is not possible here to discuss any of the other conceptions of Mendelian heredity, which the authors describe, but enough has perhaps been said to make the reader realize that the modern ideas of Mendelian heredity, differing widely from the earlier ideas which went under the same name, are decidedly complex, but exact.

Just how far are they facts, and how far theories, the reader may well ask. It can only be replied that beyond the observed results of hybridization, all is hypothesis. Many who are engaged in the study of heredity do not even accept the hypothesis that the chromosomes are the carriers of the substances or factors which lie at the base of heredity.

Nevertheless, Dr. Morgan is unquestionably correct when he remarks in the preface that the view set forth in the book, a few features of which have been glanced at in this review, is the

view held by a large number of those who have gone most deeply into the subject.

"Exception," he continues, "may perhaps be taken to the emphasis we have laid on the chromosomes as the material basis of inheritance. Whether we are right here, the future—probably a very near future—will decide. But it should not pass unnoticed that even if the chromosome theory be denied, there is no result dealt with in the following pages that may not be treated independently of the chromosomes; for, we have made no assumption concerning heredity that cannot also be made abstractly without the chromosomes as bearers of the postulated hereditary factors. Why, then, we are often asked, do you drag in the chromosomes? Our answer is that since the chromosomes furnish exactly the kind of mechanism that the Mendelian laws call for, and since there is an ever-increasing body of information that points clearly to the chromosomes as the bearers of the Mendelian factors, it would be folly to close one's eyes to so patent a relation. Moreover, as biologists, we are interested in heredity not primarily as a mathematical formulation but rather as a problem concerning the cell, the egg, and the sperm."

To this the reviewer can add that the chromosome view appears to have gained ground in America during the past year or two, among these who are most competent to hold an opinion on the subject; and that despite the strong opposition of some biologists of note, no alternative explanation has been put forward which has met with any except a limited acceptation.

Finally, to sum up the main features of the mechanism of Mendelian heredity, as understood by the authors of the book under discussion, and many other geneticists, we find among our ideas the following:

1. That the various characters which make up the physical constitution of any individual plant or animal are due to the action (concurrently with the environment, of course) of what we term, for convenience, factors, separable hypothetical units in the germ-plasm, capable of independent transmission.

2. That each visible character is due to the cooperative action of an indefinitely large number of factors (for such a simple creature as the fly Drosophila, there may be ten or twenty millions); conversely, that each of these factors affects an indefinitely large number of characters.

3. That these factors, or their material bases, are passed from one generation to another in certain bodies called chromosomes, in the egg and sperm.

4. That the factors are generally linked together in groups, each chromosome having a group of its own; that they are arranged along the chromosome in a linear series, but sometimes change places with each other by "crossing over." To these propositions there are a number of corollaries which cannot here be mentioned.

If the conclusions above listed stand the test of time in anything like their present form, genetics can well challenge every other science to produce a greater body of results in fifteen years.

High Fecundity in Hens Not a Unit Character

An editorial footnote attached to Slocum's article on poultry breeding in the November issue of the JOURNAL OF HEREDITY (p. 485) unintentionally misrepresented the work of Dr. Raymond Pearl and the Maine Experiment Station, by stating their conclusions to be based on the belief that high egg production in hens is a unit character. This statement was entirely incorrect. Dr. Pearl has presented data in several papers to show that fecundity in poultry is a character influenced by at least three separate and distinct heritable factors. He has never stated that he thought it a unit character.

SAVING THE KOKIO TREE

Wild Relative of Cultivated Cottons Becomes Nearly Extinct in Hawaii, But is Rescued For Plant Breeders—May Be of Value in Hybridization—Other Species Similarly Threatened

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AND THE EDITOR

WHEN Captain Cook discovered the Sandwich (Hawaiian) Islands in 1778, the naturalist, Nelson, who was in his party, collected specimens of a tree cotton indigenous to the islands, and later deposited them in the British Museum. From the imperfect specimens there, Seeman described[1] the species as *Gossypium drynarioides*.

The plant was long lost to sight; many years later three trees were found by a colonist, but again lost; and when Hillebrand, in 1888, described the flora of the Hawaiian Islands, he was able to cite[2] only five trees of this species. "It is much to be feared," he added, "that this rare and interesting tree is doomed to extinction, as it grows in regions mostly accessible to cattle."

The tree mentioned was known to the natives as kokio (pronounced ko-kee'-o); its close relationship to the commercial cotton plants is indicated by the fact that Seeman placed it in the same genus. Reaching a height of 12 to 25 feet, it produces large, somewhat trumpet-shaped, brick-red flowers, the petals of which are 3 to 4 inches long; and later each flower gives rise to a seed boll, containing several seeds covered with a short, reddish-brown hair.

In itself, it appears to have no economic importance; but since the rise of the science of genetics has given breeders such a keen realization of the value of the wild relatives of important cultivated plants, it was impossible that this wild cotton should escape consideration, as of possible value in hybridization with the low-growing species commonly cultivated. But when the attempt was made to get this tree-cotton, it was found to be almost too late. There was grave doubt as to whether the tree could be saved from absolute extinction. It is the purpose of this paper to describe the measures by which an exceedingly rare plant of great interest has been saved from perishing altogether.

BOTANISTS BECOME INTERESTED

It was in 1911 that this red cotton of Hawaii came to the attention of the Office of Foreign Seed and Plant Introduction of the United States Department of Agriculture, through the receipt of four seed bolls from the Superintendent of Forestry in Honolulu. The data in regard to the kokio, at that time available to men of science, were exceedingly meager, consisting, aside from a few specimens, of very short and incomplete botanical descriptions. As the seed came in as a cotton, it was referred to Frederick L. Lewton, curator of the division of textiles of the United States National Museum, who was greatly interested in the cotton genus. He at once recognized the value of the material and upon his suggestion a request for more was sent back to Honolulu. Shortly afterward a few more seeds were secured through the activity of Joseph F. Rock, the botanist

[1] Seeman in Fl. Vit., 1865, p. 22. He notes that he was undecided for some time as to what genus should receive this tree.

[2] Flora of the Hawaiian Islands, by William Hillebrand, M.D. Heidelberg, 1888, p. 51.

THE KOKIO TREE OF HAWAII

An almost extinct relative of the cultivated cotton, the seeds of which have been distributed to the Botanic Gardens of the world, in an attempt to save it from extinction. Whether it will cross with the cultivated cottons, and what the hybrid would be, are yet unknown. This tree stands on an old lava bed in the Island of Hawaii, and, through the action of the United States Secretary of Agriculture and the Governor of Hawaii, has been protected from destruction by cattle. (Fig. 6.)

who had collected the seed—who had, in fact, actually discovered the trees from which the seed came.

When it was realized, not only that this wild cotton was scarce but that it might in a few years, or even in a few months, become extinct altogether, the Office of Foreign Seed and Plant Introduction took immediate steps to arouse interest in preserving it. The narrow margin of safety will be realized from an extract of one of Mr. Rock's letters dated March, 1912:

"I have been on the island of Hawaii for two months and have just visited the section in which these most interesting and beautiful trees grow. I am sorry to say that some of the trees I found alive on my last visit have died; but I found another section where there are three more trees in very good condition. I have brought up the question of preserving these trees, but until now hardly anything has been done.

"The lessee of the land of Puuwaawaa, where some of the trees grow, has just applied for some more land where these last-found trees grow, and I have suggested that it be made a condition in the lease that these trees be fenced off in such a way as to protect them from any kind of animal. Each tree will be given an area of half an acre, in order to protect the growth of young trees. The question now is to protect the trees by law from the inhabitants, who strip the trees of their bark, which they use in dyeing their fish-nets; the color of the sap is reddish and it is waterproof."

DANGER FROM CATTLE

Mr. Rock adds that the trees grow on very arid land where vegetation is scarce; cattle therefore strip the trees of all the branches they can reach. The fruiting season is in July or earlier.

"On Molokai," he continues, "the kokio has become a thing of the past, as the last tree which I found on the west end of the island has succumbed to the ravages of sheep, goats, and cattle.

"Many are the trees that should be protected; for example, the newly-described genus, Hibiscadelphus, with two species, of each of which there is only one tree in existence.[3] Cattle are doing great harm to the native trees, and I venture to say that not many years hence these interesting plants will be a thing of the past."

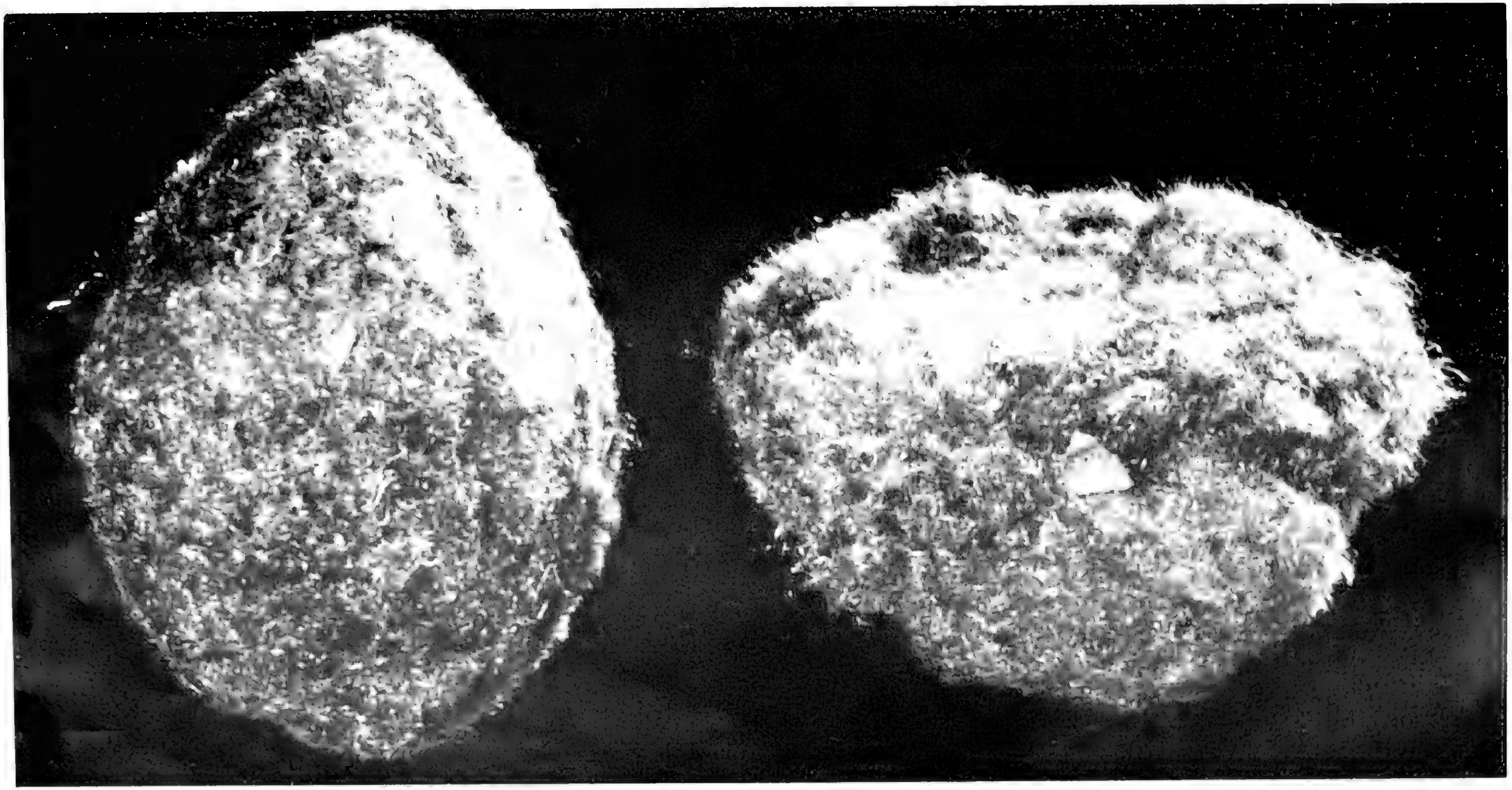
It was thereupon arranged to have all the available kokio seed in Hawaii gathered each year and sent to Washington, and the United States Department of Agriculture wrote the governor of Hawaii on the subject. He promptly took steps to protect the kokio trees, in an effective way.

Meantime, Mr. Lewton had been studying botanical specimens which Mr. Rock had collected from the island of Hawaii, and found they were different from those earlier described from the islands of Molokai and Oahu. Further deciding that the kokio was too different from the true cottons to be included in the same genus, he established the new genus, Kokia,[4] for them, retaining the original form as *K. drynarioides* and giving to the form from Hawaii the name *K. rocki*, in honor of its discoverer.

In the next year several pounds of kokio seed were received by the Office of Foreign Seed and Plant Introduction, and distributed to more than sixty botanical institutions throughout the world, mostly in tropical and subtropical countries. In general, attempts to grow the seed met with poor success, but they were established in several different localities. The distribution will be continued for some time, in order that this genus may become as widely dispersed as possible.

[3] The loss to science, if any considerable part of the native flora of the Hawaiian Islands is destroyed, may be inferred from the fact that about 80% of the species in the islands are endemic—that is, are found in no other region. Excluding small islands such as St. Helena, this percentage is surpassed only by Western Australia, where it approaches 85. The percentage of endemic species in Central America is 70, in India 60, in Ceylon less than 30. It is obvious that the loss of a species from Hawaii will in four cases out of five mean its loss to the entire world.

[4] Lewton, Frederick L. Kokia. A new genus of Hawaiian trees. Smithsonian Misc. Coll., Vol. 60, part 5, Oct. 22, 1912. Like the native name on which it is founded, this generic name is accented on the middle syllable.



SEEDS OF THE KOKIO TREE

The photograph, [illegible] enlarged, shows the short covering of red hair on these seeds, which are usually from one-half to three-quarters of an inch in length. These seeds are not known to be used by the natives, but the bark is stripped from the tree and used in dyeing [illegible]. This practice has led to the destruction of many of the trees, but is now stopped by government action. (Fig. 7.)

While on a visit to the Hawaiian Islands in the summer of 1913 to study the taro industry, the senior author made a trip to the North Kona region on Hawaii where the kokio is found, and through the courtesy of Robert Hind, owner of the Hind Ranch at Puuwaawaa, was enabled to visit the trees nearest the ranch headquarters. The hearty co-operation of Mr. Hind was an important factor in successfully carrying out the plan to protect, by fencing, the larger grove of kokio trees on the leased Government land.

GROWS ON LAVA BED

The little group visited, consisting of four trees, is perhaps a mile from the headquarters, which are at the base of the old volcanic cone, Puuwaawaa, on the slope of Mt. Hualalai. Immediately on leaving the grounds about the house one comes to the lava bed on which the kokio trees grow. This bed, while more or less covered with scrubby growth, has as yet scarcely begun to decompose, and is therefore exceedingly rough and difficult to traverse, even on horseback. The residence on the ranch is at about 2,700 feet elevation, while the kokio trees are a few hundred feet lower. The annual rainfall at the ranch averages 29 inches but is probably much less where the kokio trees grow; besides this, the dry air and the winds which frequently follow the showers, quickly absorb the moisture from the rocky soil. The flora of the lava bed is of a desert type.

The trees do not stand close together; in some cases they are separated by several hundred feet. They are surrounded by the shrubs and weeds common to the lava field in that vicinity. The photograph of the best of the four trees, reproduced on another page, shows the general habit of growth at this place, and the surrounding vegetation. It fails, however, to give any idea of the rough character of the surface of the lava. Much of the shrubbery had to be broken down before the tree could be photographed satisfactorily. The other trees in this group were less regular in form and more spreading in proportion to their height than the one shown. Mr. Hind is standing beside the tree.

As a result of four years of diligent effort, the kokio may safely be considered now to have passed beyond the danger of extinction. It is to be hoped that equally successful efforts will be made to save other wild relatives of cultivated plants, not only from sentimental reasons but because any one of them, even the least promising in appearance, may turn out, in the hands of plant breeders, to be of great value to the world's agriculture.

New Publication on Eugenics

"Eugenical News," a bi-monthly newspaper published by the Eugenics Record Office, Cold Spring Harbor, Long Island, N. Y., has appeared in the first issue of its first volume, under date of January, 1916. It covers four pages, six by nine inches. Primarily intended to disseminate news about the Record Office, it will also include within its scope news of the progress of eugenic research in general, of new laws and institutions which bear on eugenics, and "facts as to differential fecundity, facts as to the control of the death rate of different social classes and of national immigration and emigration."

SEX IN LIVESTOCK BREEDING

Inheritance of Many Characters is Affected by Sex, but this Phase of Heredity Does Not Offer Great Possibilities to the Practical Breeder at the Present Time

E. N. Wentworth

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SOMATICALLY there are four types of inheritance with reference to sex. The first category of character is entirely independent of sex; the second is linked to the sex-determining factor in transmission; the third differs in expression according to sex, although the zygotic constitution is the same; and the fourth is confined to one sex, although it may appear in a rudimentary form in the other. The first two groups develop independently of the secretions of the sex glands, the second two are conditioned in their development by the presence and activity of the testes or ovaries. In the first group fall the great bulk of characters observed in domestic animals; in the second a number of characters observed in insects, birds and man; in the third a few cases in mammals with an instance or two in insects; and in the fourth, the mass of secondary sexual differences found in birds and mammals. Just where the secondary sex characters of insects should be included is at present doubtful.[1]

CHARACTERS INDEPENDENT OF SEX

Evidence on characters totally unrelated to sex is unquestioned, the hundreds of experiments substantiating Mendel's law being cases in point. Some of these discoveries have been of real economic interest, as for example the transmission of the polled character in cattle or the inheritance of coat-color in horses.

SEX-LINKED INHERITANCE

The second group of characters has been of particular interest to investigators, because of the parallelism afforded between the transmission of such characters and the distribution of the so-called X-chromosome in gametogenesis and fertilization. The practical application of this knowledge, however, seems at present limited to the field of poultry, although there are certain facts which point to an ultimate usefulness in the breeding of dairy cattle.

THE BARRED PLYMOUTH ROCK

The knowledge (Spillman, Goodale, Pearl and Surface) that the cock has apparently two doses of the sex-linked characters, while the hen has but one, has proved of value in the breeding of Barred Plymouth Rocks to the show standard. A certain shade of barring is desired in this breed and it has always been a difficult problem to get flocks that would produce both males and females that were standard. When standard males were mated to standard females, the progeny were too light and the females were too dark. Cocks that sired standard females always sired light males, while cocks that sired standard males always had to be mated to dark females for this purpose and moreover produced very dark daughters.

The apparent explanation of this difficulty is that the factors which reduce the degree of pigmentation and produce the white bars are cumulative in effect, and the male that is duplex for the barring factor is lighter than a simplex male or the female. One needs, then, two flocks in order to produce standard fowls. The female producing flock will have light males while the male producing flock will

[1]If the sexual glands of caterpillars are removed at a very early age, the butterflies produced by these caterpillars nevertheless show all the expected secondary sexual characteristics. It appears, then, that these characteristics are wholly independent of the secretions of the reproductive organs.

utilize standard males and dark females. While this is the natural explanation of the facts, and gives the desired results, it would be far better for breeders to recognize that there is a true sex difference, and to make the standard for females proportionately darker than the standard for males.

HIGH EGG LAYING POWER

Pearl (1912) has rendered a great service from an economic standpoint through his discovery that high laying is inherited as a sex-linked factor. By high laying is meant the ability to produce more than thirty eggs during the winter laying period of the pullet year. This is simply a standard which by careful mathematical methods has been shown to be very closely correlated with high laying throughout life. It does not mean that a hen which does this and then stops laying is a high layer, although such a hen is probably potentially a high producer, her failure being due to some extraneous cause.

By selecting the males and females on the old idea of breeding the best to the best (males from two-hundred-egg hens to females laying above 150 eggs), during a period of ten years, there was no significant change in the mean production of the flock. As soon as the system of selection was based on the knowledge that the high laying was due to the inheritance of a sex-linked factor (Pearl, 1915), the average began to rise and in the first year, November, 1913, to July, 1914, the flock produced more eggs per hen than even in an artificial year made up of the best months during the ten years of mass selection.

POSSIBILITIES IN DAIRY CATTLE

Cole mentions the fact that dairy cattle men have believed that the male influences the milk flow of the daughters more than the female does, and quotes one or two authors on the subject. Definite evidence on the point is difficult to obtain, although there have been suggestions at various times that sex-linkage may be involved. In a study of 5,691 Holstein cows with their daughters, two of the writer's former students, Hills and Boland, discovered a correlation of 0.29 between the maternal records and those of the offspring.

If the cow is homozygous for the sex factor, as seems probable, and if the animals studied were perfectly heterogeneous, this might indicate a sex-linkage of certain of the production factors, as a correlation of less than .25 would normally exist. An alternative explanation is possible, however, as the material studied was selected on an advanced registry (high production) basis, and the daughters which failed to attain the standard were not included among the advanced registry individuals. This would tend to raise the correlation coefficient perhaps sufficiently to account for the amount noted.

SEX-LIMITED INHERITANCE

What was designated in the first paragraph as the third type of inheritance has frequently been assumed to be a form of sex-linked inheritance. Arkell and Davenport have devised a scheme which bridges all of the voids between the true sex-linked inheritance and the characters whose expression is affected by the sex gland, but it is doubtful whether such an explanation is necessary since that assumed by Professor Wood, the discoverer of the phenomenon, is both simple and reasonable.

Wood crossed Suffolk sheep, polled in both sexes, with Dorset sheep, horned in both sexes, and obtained horned males and polled females. When such crossbred horned rams and polled ewes were mated, the male offspring showed three horned individuals to one polled, while the female offspring showed one horned individual to three polled. Dominance was reversed in the two sexes, the horned character being dominant in the male and the polled character being dominant in the female.

A few years ago the writer discovered a character in swine which showed a similar mechanism of inheritance. On the lower part of the scrotum of the male, and well to the rear of the inguinal pair of mammæ in the female, there frequently occurs a small rudimentary pair of mammæ. This character has been shown to be dominant in the male and recessive in the female,

as a result of observations on a large number of animals, about 3,000, and also as a result of a few directed crosses.

This last spring, due to the kindness and cooperation of Professor O. E. Reed, of the department of dairy husbandry, Kansas State Agricultural College, facilities were extended the writer whereby another character was discovered which falls within this category. The Ayrshire herd bull, Melrose Good Gift, is a dark mahogany and white in color, what is popularly known as black. The occurrence of black and white Ayrshires was recently discussed in the JOURNAL OF HEREDITY by Kuhlman. It is difficult to determine whether the dark hairs are due to excessive deposition of red pigment within the hair or whether there is really a black pigment. Microscopic examination seems to indicate the latter condition, but the statement is only tentative.

When Melrose Good Gift was mated to red females, his male offspring were all black and his female offspring were all red. Nine black males and eight red females have resulted from this cross to date. Matings representing the F_2 cross are very few, only two being available. One black bull and one black heifer have resulted. The black is the most reasonable expectation in the male, but the chances in the female would be three reds to one black. Two black cows are in the herd and their progeny are as follows: one black male and three black females by the homozygous black bull (the expectation); two black males, two black females, and one red female by heterozygous black bulls (also the expectation); and one black male and one red female by red bulls (the same types as in the first cross mentioned). Other types of crosses exist, all of which supply confirmatory evidence for the conclusions already drawn.

SECONDARY SEX CHARACTERS

The term sex-limited inheritance was first used for the secondary sexual characters, but its usage has varied so that the writer prefers to adopt the terminology herein presented. Information on these characters is classic, Darwin having dealt with them in an exhaustive manner in the materials supporting his theory of sexual selection. Sex differences are familiar to the livestock breeder, the inhibition of their development by unsexing being common, and it is doubtful if there are any practical possibilities involved in this subject that are not already realized by the breeder.

APPLICATION TO PRACTICAL BREEDING

The breeder's problem relating to sex and livestock is the practical one. It can hardly be denied that either form of sex-affected inheritance exists, but the breeder requires more than the mere existence of a fact to make use of it. The study of the individual character has shown that its distribution can be controlled with little difficulty, but no practical means is known of beating the old method of mating the best to the best, when the large number of characters are concerned on which pure-bred selection is based. In the face of Pearl's remarkable work on poultry, it seems ultra-conservative to make this statement, but no one has yet shown how any of the Mendelian knowledge can be applied to the breeding of Poland-China or Hereford. The livestock industry is so much more intimately involved with finances than with ultimate breed improvement that it is not fair to ask any related biological fact to reduce itself to monetary terms. Some facts have been able to be so reduced, but the majority may never be. Yet this condition is by no means a cause for despair, as the solution is perhaps not distant. In the meantime the geneticist will continue to contribute his quota to livestock breeding, whether his contribution be "linked" or "limited," remembering that in the course of the world that which is most fundamental is ultimately the most practical.

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Race Hygiene in Germany

The semi-official "Deutsche Zentralstelle für Volkswohlfahrt," corresponding to the United Charities in America, held a three days' meeting in the parliament in Berlin from October 26 to 28, 1915, with about 1,000 delegates attending. The conference was called "Tagung für die Erhaltung und Mehrung der deutschen Volkskraft," with the purpose to find ways and means against the evil consequences of war and modern civilization which menace the vitality of the race. The war kills the best, the bravest, the healthiest, eradicating once for all the finest strains in the race; and city life with all its attendances causes a declining birth rate. The discussion was marked by a unanimity seldom seen in such a large audience. The dominating undertone was race hygiene. Whereas eugenics in America has a restrictive tendency, seeking to check the propagation of the unfit, race hygiene in Germany always was a positive conception aiming at the multiplication of the fit. Thus the conference laid much stress upon everything which may elevate the birth rate of the best in the nation, but thought the introduction of sterilization of defectives or of marriage certificates untimely as yet. Simplicity in customs and mode of life, a full understanding of individual duty towards society, a high valuation of family life, inner colonization ("back to the farm" movement), the system of one-family houses, garden cities, and chiefly the assistance of large healthy families in every way; these were the main remedies proposed, the details of which were fully discussed but cannot be enumerated in a short review. A standing committee representing all societies concerned is now in formation with the view to see the propositions worked out in practice.

G. von Hoffmann, Berlin.

An Important Character in Grains

Certain varieties of wheats, oats and barleys are characterized by fragile articulations, so that the ripe grains easily fall from the head, thus causing a considerable loss of grain before threshing. In crosses, such a defect not infrequently manifests itself, and it would be of great advantage to the breeder to know how to avoid it. G. von Ubisch has been investigating this character in barley and states his conclusion in the *Zeitschrift für induktive Abstammungs-und Vererbungslehre*, July, 1915, that it depends on two Mendelian factors, both of which must be present to produce this effect. If his conclusions are sustained, they will be of great value to breeders of cereals.

Cross and Self-Fertilization

Working with cotton, the Arkansas Agricultural Experiment Station is testing the effects of cross and self-fertilization, in four different degrees, comparison being made of the results when blossoms are self-fertilized, when they are pollinated from other blossoms on the same plant, when pollinated from another plant of the same variety, and when pollinated from a plant of a different variety. Since Darwin's classic experiments, very little notable work has been done in this field, but the claim of the harmlessness of self-fertilization, put forward largely on theoretical grounds by various recent students, renders it necessary that the question should be again taken up and new evidence procured. The Arkansas station hopes to be able, by this series of experiments, to get absolute measurements of the results produced by the various degrees of close-breeding. While the question is one of great theoretical interest, particularly for the bearing it has on the evolution of sex, it has also a practical importance; for if it were generally admitted that self-fertilization is injurious, breeders would change their methods in many cases.

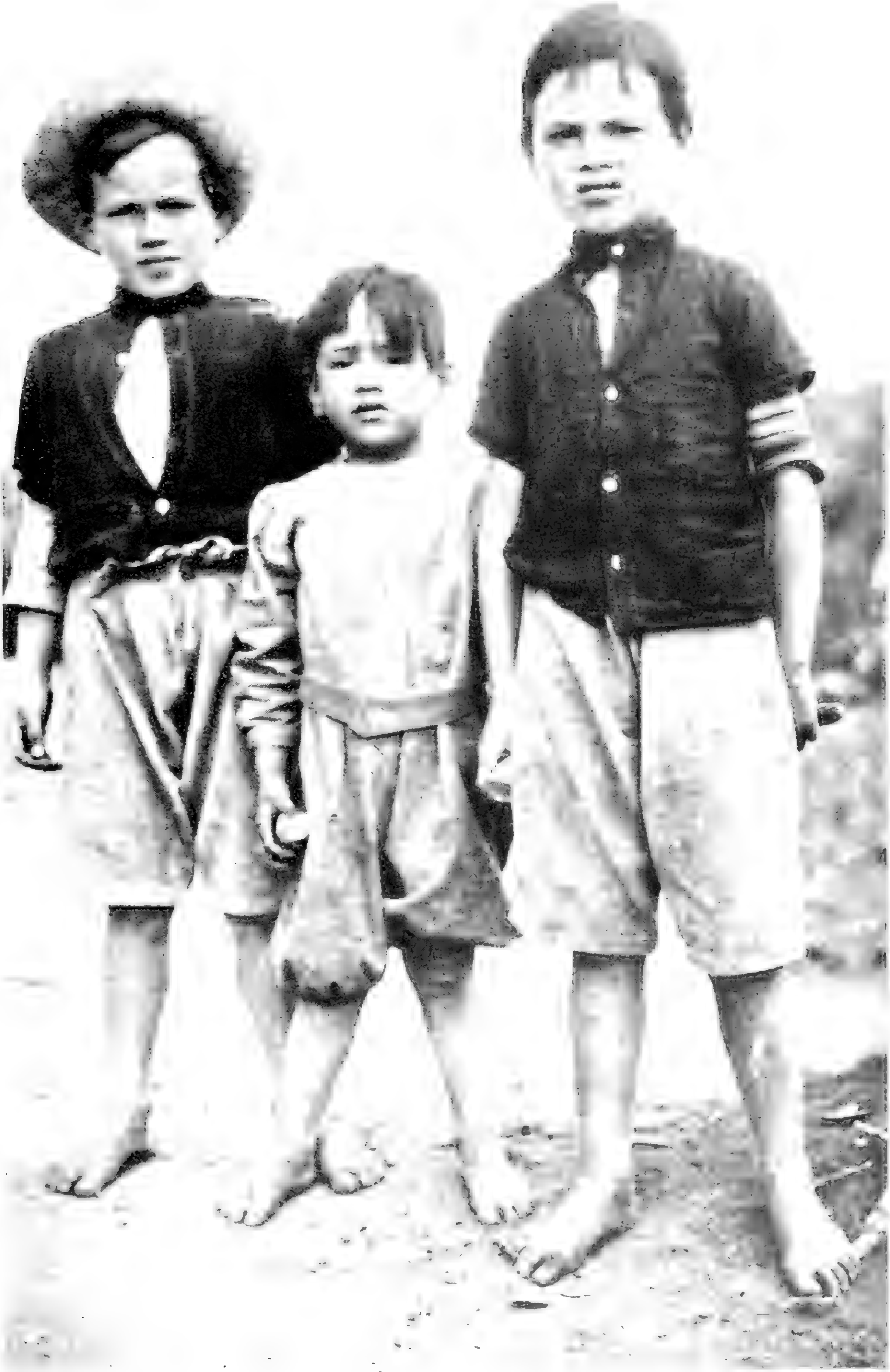
The question of cross- vs. self-fertilization and its effect on vigor should not be confused with the question of hybrid vigor, for there is little doubt that most first-generation hybrids show marked vigor—to such an extent that corn, tomatoes and many other crops are best grown from first-generation hybrid seed. The distinction which the Arkansas and other stations are developing, is rather along the line suggested by A. D. Shamel's statement, in the second annual report of the American Breeders' Association, that "Self-fertilized tobacco seed, the result of the closest possible degree of inbreeding, has been conclusively demonstrated by four seasons' experience and experiments in extensive fields of different varieties of tobacco to produce more vigorous plants than seed cross-fertilized within the variety. Crosses of different strains of tobacco, however, give increased vigor of growth, leaf and seed production."

It should be noted that Darwin's own experiments did not show self-fertilization to be detrimental in every instance. Notably in the case of the California poppy (*Eschscholtzia californica*), self-fertilized seeds produced plants which surpassed the plants from cross-fertilized seed, in three out of four cases. So it is possible that conditions may vary with different plants, although one is naturally inclined to suppose that a principle of such fundamental importance in the struggle for existence ought to hold good throughout nature.

But even before this problem is finally settled, there are some lines in which breeders can work with great possibilities of commercial profit, and the Hawaiian experiment station has started one of these, by attempting to breed a strain of papayas (*Carica papaya*) with self-fertile flowers. The papaya, one of the important fruits of the tropics, is irregularly monoecious; obviously, if male trees could be altogether eliminated, a considerable saving would occur in planting. Since trees with perfect flowers are occasionally found, the station is endeavoring to make this type supplant the ordinary monoecious type altogether. The experiment is now in the second generation, in which more than 400 trees were raised; 96% of them were self-fertile, the few remaining trees not being exclusively male in character but showing a strong tendency to bear fruit. As in nature the males make up about half of the trees, the economy of space should be large when the new strain is perfected.

IGORROT X AMERICAN METIS

The effect of racial crosses can be studied to good advantage in the Philippines, where intermarriages of many different racial stocks have taken place during the last few generations. The above photograph shows an Igorrot woman with her four children by a white American husband. The Igorrots, one of the principal tribes of the islands, are



of Malayan origin. The student of heredity will be interested to note to what extent the characters of the mother dominate over those of the father, in the children. These photographs were taken at Atok in the province of Benguet on the first of January, 1915. (Figs. 8 and 9.)

DAVID B. MACKIE, *Manila, P. I.*

OSTEOPSATHYROSIS

Extraordinary Fragility of Bones Occasionally Found in Babies is Due to Heredity and Behaves as a Dominant Trait in Transmission—Usually Found Associated with a Porcelain Blue Color of the "Whites of the Eyes."

A Review

ON July 11, 1893, a boy was born under normal circumstances who, when examined by the attending physician, was found to have appeared in the world with both thigh bones broken. The legs were put in splints and union of the bones occurred in three weeks.

On September 11 he broke an arm and a leg, but they again united nicely.

On March 1, 1894, the boy, sitting in a chair, fell forward but not out of the chair and suffered a fracture of the right femur near the hip.

On September 11 his left thigh bone was broken again; a union occurred, but in October the bone was fractured once more.

In the spring of 1895 he fell out of his hammock and broke both thigh bones; three months later the right one was again fractured.

It is thought that he suffered fractures at other times, that were less carefully noted. At any rate, by the time he was 2 years and 10 months old a careful examination revealed certainly twelve fractures and possibly seventeen or eighteen; but already they had begun to occur less frequently.

The following points about the case are worthy of notice:

(1) In early infancy there was an extraordinary liability to fracture;

(2) but it began to diminish as the baby grew older;

(3) the fractures occurred from trivial knocks and, apparently, even from merely internal muscular stresses;

(4) healing took place rapidly and left little irregularity in the bone at the point of union. The bone was perfectly healthy and rigid, but the development of a strong structure was much delayed. The bone was not diseased or soft, but was merely fragile.

Cases of this kind are not rare in medical literature, where the affection is known as *osteopsathyrosis*. The cause has been shown by a number of investigators to be an imperfection of the developmental processes involved in the formation of bone. In the ordinary course of development the whole bone is finally enwrapped in a casing of extremely tenacious and flexible bony rods; but in this condition such rods are not formed. There are other abnormalities of the mechanical structure.[1]

One case is on record of a pair of twins, one of whom showed at birth this defective condition of the bones, while the other did not. Inevitably, therefore, we must suspect that the abnormality is not due to anything in the condition of the mother, for in that case both the children should have been affected.

Nor can it be due to anything in later life, for we find that the child's bones are sometimes broken at birth, as in the case cited, or even before.

EVIDENCE POINTS TO HEREDITY

When we find, moreover, that the appearance of this condition is not haphazard, but that it runs in families, we are driven to the conclusion that it is not a result of any environmental conditions. It is a matter of heredity. Either, we may suppose, the child lacks certain hereditary factors that normally perfect the structure of the bone, or perhaps it has received some additional

[1] Such a condition is easily confused with the disease of children known as rickets, and it is possible that some of the cases which figure in the present study are really rickets. The difference between the two is that in rickets there are usually other widespread abnormalities of the skeleton, while in the defect here considered the skeleton is perfect save for the unusual brittleness.

factors that inhibit the action of the normal ones.

As students of heredity, therefore, Professor H. S. Conard, of Grinnell College, and Dr. Charles B. Davenport, of the Carnegie Institution, have reviewed the literature on the subject, added some new cases, and published their conclusions in a bulletin[2] of the Eugenics Record Office. They accept the finding of Schwarz and Bass (1912) that heredity is the only important etiological factor in bringing about this condition, and are able to quote thirty-five family histories in support of it. As an example we notice the chart of four generations of a family found by Professor Conard:

In the first generation are two affected brothers, one of whom had a thigh broken merely from the muscular strain on a turn while dancing. The other brother has a record of a broken thigh and dislocated hip.

From the latter are eight children, half of whom showed the father's abnormality.

In the third generation the number of affected persons becomes still greater, although none of the second generation children had married mates with similar taints.

One of the girls of the third generation, however, married a man who, though not himself affected, had affected cousins. From this union there are five children of the fourth generation, every one of whom shows the abnormality.

From this and other cases the authors reach the conclusion "that the factor which determines the imperfect, brittle development of long bones is a dominant one. This conclusion is based on the fact that, as Griffith (1897) pointed out, the inheritance is generally direct, *i. e.*, does not skip a generation, but appears in one parent and in that parent's parent. Since the trouble frequently shows itself only in early childhood there are, of course, the expected number of cases where a similar condition is not known in either parent, one or both of whom are perhaps dead. But even in such cases the trait is frequently recorded for a brother or sister just because they are contemporaries. Beyond a certain point in the pedigrees, in any case, information must be lacking. What is to be expected on the hypothesis, and what is found, is that affected children rarely if ever arise from an unaffected parent and an affected grandparent."

CONSEQUENCES FOR EUGENICS

"The consequences of this study for eugenics are these: A parent who is, or was in early life, osteopsathyrotic, will have half of his children similarly affected no matter whom he marries; except that if the consort also be osteopsathyrotic it is to be expected that three-fourths of the children will be affected. But if neither parent has shown osteopsathyrotic tendencies then, no matter how frequent the tendency may be among their relatives, expectation is that none of the children will have brittle bones. Moreover, where a parent is affected it is probable that his children will show the same tendency at about the same time in life, in the same bones, and to the same degree as he himself has shown it. As to how far that expectation should influence the reproduction of children the affected parent can best judge from his own experiences."

It will, of course, be understood that the proportions mentioned by the authors are merely averages, reached when large numbers are measured but not likely to be found exact in individual families. Their own study embraces a total of 150 persons, of whom eighty-three were affected. Thus they found 55.3%, whereas expectation from larger numbers would have been, as they say, only 50%.

The classification is admittedly rough, and it seems likely that under the name of osteopsathyrosis physicans have lumped a number of distinct but allied conditions that a geneticist would have separated. Or as the authors

[2] Hereditary Fragility of Bone (fragilitas osseus, osteopsathyrosis), by H. S. Conard and C. B. Davenport. Eugenics Record Office Bulletin No. 14, Cold Spring Harbor, Long Island, N. Y. November, 1915. Pp. 31, price 15 cents.

put it, the "classical symptoms" probably constitute a complex character whose elements are separately heritable. Much more extended and minute research will be necessary before the problems involved in the inheritance of fragility of bone are settled, but one fact, at least, seems established: that it is heritable, and in the general manner of a dominant trait.

One other fact is worthy of note: this bone abnormality seems usually if not always to be associated with a blue color in the "whites of the eyes." It has been noticed ever since 1840 in medical literature that there are families in which the blue color characteristic of the eyes of infants seems to persist through adult life, and in 1900 Eddowes pointed out that this condition and fragility of bone were correlated. This abnormality of the eyes appears to be heritable and dominant, but as to why it should be associated with brittleness of bone we have no information at present.

Studying Fruits in Illinois

Many seedling apples are being grown at the Illinois Experiment Station. Reciprocal hybridizations between standard orchard varieties and various species of the genus Malus have been made, fifty-seven species and varieties which are not of commercial importance having been obtained from the Arnold Arboretum at Boston. Direct improvement through these violent crosses is not anticipated, but it is hoped to acquire valuable information regarding the affinities of the various species used, and also to produce material for use in back crossing. Reciprocal crosses between standard orchard varieties are also being made in large numbers, while a difficult piece of work has been attempted in the reciprocal crossing of different strains of the same variety, and different individuals of the same strain. C. S. Crandall writes: "This project has aimed at the selfing of particular individuals, and the use on trees growing here of pollen from trees of the same variety in orchards 100 miles away and grown under quite different conditions. Considerable effort has been expended in the prosecution of this project, but up to the present time we have recorded no successful pollinations. We have not as yet a very wide range of varieties, but as far as we have gone we have encountered complete sterility both in the selfing within the individuals and in the attempt to use pollen of the same variety brought from a distance. The unfortunate feature about all the hybridizing work with apples is the mongrel character of the plants on which we work. We know nothing of the parentage of any of our varieties and it seems quite useless to speculate on what the segregation of characters may be in crosses between different varieties. A further discouraging feature in apple breeding is the long period required to get results from any particular cross. Effort is being made to shorten this period by grafting scions of hybrid seedlings on dwarf stocks and growing the plants in pots. This will help some, but at best the attainment of results is some distance in the future. We are endeavoring to maintain a reasonably complete record of every step that is taken so that a complete history may be available for those who may later continue the work.

"In pursuing the projects as outlined above there are a number of minor problems that are receiving some attention: such as the retention of the vitality of pollen, the period of receptivity, the seed production in hybrid fruits, and the time for and percentage of the germination of seeds. On all of these points we are accumulaing considerable information that it is hoped may be of some practical value."

ANCESTRY OF THE GOOSE

Ordinary Domestic Breeds Are Descendants, with Slight Modifications, of the Gray Lag Goose, Still Found Wild in Most Parts of the Old World—Breeding in Captivity Must Have Begun at Early Date—Importance in Antiquity

NATURALISTS are agreed that the ordinary breeds of domesticated geese are descendants of the gray lag goose (*Anser anser*, L.) which is still found wild throughout northern Asia, although nearly extinct in Europe.

As it is easily tamed, it was probably brought into captivity at a very early day. E. Hahn suggests that it was the first bird domesticated by man, and as far as Europe is concerned he is doubtless right.

More ancient than their congeners the ducks and swans, the geese stand about half-way between them, in most points of form. The ancestry of these three groups, which make up the Anseres, is not difficult to trace, for the key is furnished by two strange, aberrant forms of goose in South America—Palamedea and Chauna, commonly known as the "Screamers." If, says W. P. Pycraft,[1] the Anseres are not descendants of the archaic Screamers, they at least come from the stock from which these arose. "That is to say, the Screamers may either be regarded as the living representatives of the actual ancestors of the Anseres, more or less modified by time, or as an offshoot of these ancestors retaining most of the original characters thereof."

When man first entered Europe, the gray lag must have existed in immense numbers. Its range is from Iceland to Kamchatka, north occasionally as far as the arctic circle and south to the Mediterranean. It winters principally in India and the adjoining countries.

Pairing for life,[2] the geese build a nest which is little better than a pile of rubbish, and in it the female lays from four to twelve, sometimes fourteen, eggs, resembling in appearance those of the domestic breeds, which she incubates for twenty-eight days. The gander stands guard, seldom moving far from the nest, but the old story that he takes his turn at incubation seems to be unfounded.

The goslings, which on emerging from the shell are covered by a short, thick down, usually take their first bath not later than one day after birth. Alphéraky[3] describes their early training as follows:

LIFE OF THE GOSLING

"At first the young birds nip off the tender tops of various waterweeds projecting above the surface, but the mother soon tries to lead them away to a green bank or an island, where they begin to graze in the fashion they will follow for the rest of their lives. Towards nightfall the brood returns to the nest, where the young are kept warm under the wings of the mother. Such is the daily life of the young brood until the goslings have grown so large that they cannot find room beneath their mother's wings; but even after this they still pass several nights huddled close to her body. The brood usually goes to feed in the following order: in front the goose, and in her wake the goslings, crowded closely together; somewhat to the rear stalks the gander, with neck outstretched, constantly turning to one side or the other, and keeping a sharp lookout for

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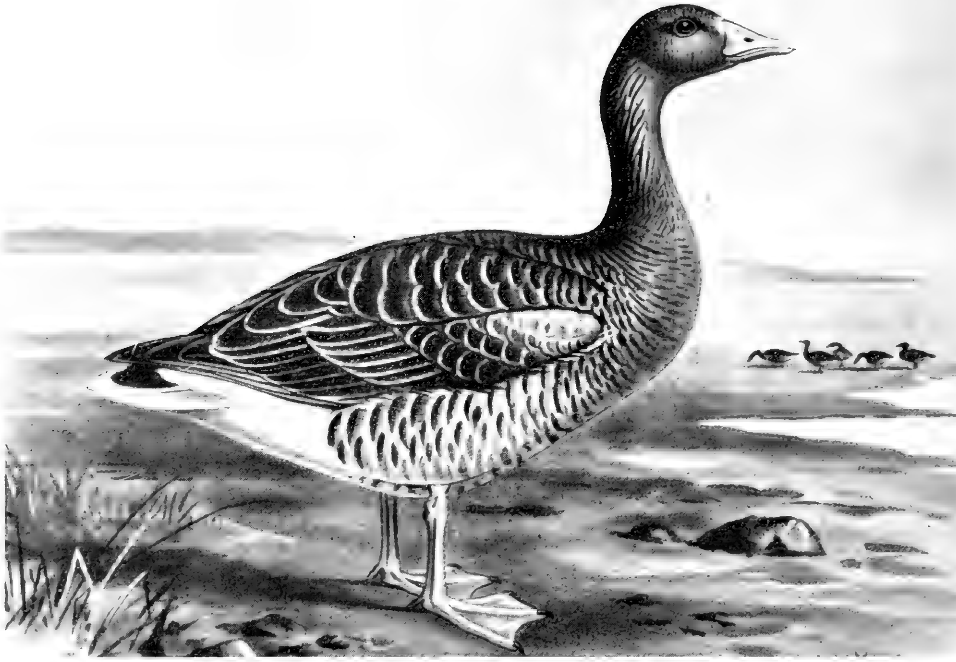
[1] History of Birds, London, 1910.

[2] Geese have always been noted for longevity. Alphéraky mentions one in France which, at the age of 35, was still producing a brood each year.

[3] Sergius Alphéraky, The Geese of Europe and Asia. London, 1905.



ANCESTOR OF THE DOMESTICATED GEESE

The gray lag goose, here illustrated, was found all over Europe and northern Asia, not many years ago, in countless numbers. Now it is almost extinct in Europe, being easily caught at the time of its moult. It was probably the first bird domesticated in Europe, because of the ease with which it is tamed, as well as because of its value. After Alphéraky. (Fig. 10.)

any threatening danger or conspicuous object. Notwithstanding this watchfulness, in case of actual danger the gander is the first to take wing with a loud cackle, or rather cry, full of fear, leaving the care of saving his children to the female, which, it must be owned, fulfils her duty with complete self-sacrifice. Her first care in the presence of danger is indeed to hide her young brood wherever possible in the grass or undergrowth, and if there be water at hand the brood will sometimes rush in headlong and seek safety in diving.

"If a gosling be caught and removed from the brood, it is said that the mother will fly at the robber and pursue him for a considerable distance. Both goslings and old birds, when they wish to hide, will lie down flat on the ground, with neck stretched out to its full length; this being the habit of large but not yet fully fledged young birds and moulting old ones; although it is not peculiar to the grey-lag, but common to all geese. In case of the death of the parents, the goslings usually join other broods, and are willingly received by the parents of the latter.

"Naumann relates a somewhat strange trait in the life of the grey-lag, namely, that sometimes the geese will fly off with their offspring from a large sheet of water to a small one, and back again, without visible cause, but with extraordinary persistence and obstinacy. When they have decided to abandon any particular water, they carry out their intention at any cost, even if all the goslings should perish in doing so. The feeble young in down, when hardly two weeks old, are transferred by their parents to other waters lying within a two or three hours' march across the

THE TOULOUSE GOOSE

This popular old French breed shows, except in shape, relatively slight differences from its ancestor, the wild lag. It has become considerably less graceful, due to the demand of its growers for as much meat as possible; on the average, it weighs probably twice as much as the wild form. The small amount of change in the color pattern is particularly noticeable. Photograph of a male, from the United States Department of Agriculture. (Fig. 11.)

open fields or along country roads, past mills, and even through settlements, so that, in such apparently aimless wanderings, the young often perish from the assaults of rapacious foes, or simply from the hardships of the journey. Even if the goslings are caught and reinstated several times on the waters whence the parents had taken them, the latter do not abandon their

PAIR OF EMBDEN GEESE

Breeders in northern Germany, particularly in Westphalia, are responsible for the production of this breed, which is rather more graceful than any other descendant of the gray lag. The creators of the Embden took advantage of the fact that the gray stock frequently gives rise to white sports, and by breeding from these sports produced a variety that rarely shows a return to the ancestral color. White geese were known as a distinct breed even in the Roman times. Photograph from the United States Department of Agriculture. (Fig. 12.)

senseless conduct, but again obstinately carry off their offspring. An attempt has been made to explain such persistency on their part by the instinct of the geese to abandon waters which, according to a presentiment, will dry up in the course of the year; but it is more probable, I think, that the tendency to wander in these birds is caused by the desire to find safer and less accessible spots for the moulting of the old birds.

ADULT LIFE

"When the goslings are fairly grown up and almost fully fledged, the old birds moult—the ganders somewhat the earlier, and after them the geese—and having simultaneously lost all their

primary and secondary wing-feathers, they become, like the ducks, perfectly helpless. Knowing this, they duly retire to still safer strongholds, where they pass this dangerous but not very prolonged period of their life.

"When the young geese have grown their flight-feathers and the old birds are fully fledged, they begin to fly out to the fields to feed, sometimes in separate broods, at other times in parties; and it sometimes happens that their feeding grounds are far removed from their places of refuge. . . . We owe to Vavilov the following lifelike description of these foraging expeditions: 'A little later the separate broods combine to form flocks; and from this moment the geese no longer fall such an easy prey to the fowler. Such gaggles feed in the corn-fields, especially buchwheat, peas and oats. Having once selected a field, they constantly fly to it, even continuing to visit it after the harvest to glean the scattered grain. At this period the geese live a life of ease and luxury. With sundown they fly to the field, crowding the crops to an incredible extent, and at the call of the old birds rising heavily and making for the lonely lake to pass the night. They always fly by the same route, and as soon as they reach water at once descend and devote their first attention to slaking their thirst, and then swim to the selected open shore, where they get out, lie down, and fall asleep. The old birds alone do not sleep, but divide the watches, and, if they hear anything suspicious, at once wake the whole flock with a loud cry of warning, and in an instant fly up into the air. . . . After a doze of an hour or two, long before dawn the geese on guard wake their sleeping companions, and again the whole flock flies off to the favorite field, where it remains until early morning. Having taken their fill, the geese now fly to another lake, where they pass the day. In the evening they again fly to the field, and so on until their departure.' "

In winter the goose is languid and inactive, passing whole days in dense growths of reeds, surrounded by quagmires, and inaccessible alike for man and beast.

Wild specimens weigh from 6 to 12 pounds; specimens as large as 16½ pounds have been reported, however. The individual variation in the coloring of the plumage and of the naked parts of the bird is subject to innumerable changes, as with all species of geese.

EARLY DOMESTICATION

The very abundance of the bird in a wild state must have tended to delay the time of domestication, for, as Hehn points out, "Where it was abundant and easy to obtain, there was no necessity for breeding it artificially in confinement; and so long as men's manner of life was unsettled, a bird that takes thirty days to hatch, and a proportionate length of time to rear its young, was unsuitable to the economy of a pastoral people."

This explains, perhaps, why we find its remains lacking in the Swiss lake dwellings, whose period is probably 2000–4000 B. C. When we come to the classical period, however, we find it well established.

"By the Greeks the goose was considered a graceful bird, admired for its beauty, and an elegant present for favored friends. In the Odyssey, Penelope has a little flock of twenty geese, in which she takes much pleasure, as we learn from the beautiful passage in which she relates her dream to her disguised husband. Here the geese appear as domestic animals, kept more for the pleasure the sight of them affords than for any profit they might bring. So, in the Edda, Gudrun keeps geese, which scream when their mistress laments over the corpse of Sigurd. At the same time, the Greeks valued geese as careful guardians of the house; on the grave of a good housewife was placed the figure of a goose as a tender tribute to her quality of—vigilance!

"Among the Romans perfectly white geese[4] were carefully selected and used

[4] There appears to be in the lag goose and its descendants a strong tendency to the production of white mutants. The same seems to be true of the Chinese species, judging from the fact that a white variety of the breed has been created.

MALE AFRICAN GOOSE

The name of this breed is a misnomer, for it is really founded on the Chinese goose, a distinct species which has the honor of being the largest of all wild geese. The Chinese species interbreeds freely with others, and the breed known as African contains varying proportions of gray-lag ancestry. The plumage of the bird here shown indicates that the Toulouse goose may be not a remote ancestor; the peculiar fleshy protuberance at the top of the beak is a characteristic of domesticated forms of the Chinese species, although it does not appear in the wild birds. The black stripe down the back of the neck is characteristic of the species. Photograph from United States Department of Agriculture. (Fig. 13.)

for breeding, so that in course of time a white and tamer species was produced, which differed considerably from the gray wild goose and its direct descendants. In ancient as in modern Italy, the goose was not so commonly found on small farms as in the North, partly because the necessary water was scarce, and partly because of the damage she caused to young vegetation. But numerous flocks of this bird cackled in the huge goose-pens (*chenobosca*) of breeders and proprietors of villas; there the enormous liver that made the mouth of the gourmand water was produced by forced fattening—an artificial disease which was poor thanks for their saving the Capitol. The use of goose feathers for stuffing beds or cushions was foreign to early antiquity; the later Romans first learned the practice from the Celts and Germans. In Pliny's time whole flocks of geese were driven from Belgium to Italy, particularly from the land of the Morini, who inhabited the Belgian coasts; the delicate white feathers which came from that country were celebrated. . . . Pillows stuffed with goose feathers were an innovation at which true Romans shook their heads: We have now arrived at such a pitch of effeminacy, adds Pliny, that even men cannot lie down to rest without such an apparatus. Even to the present day, feather-beds are more characteristic of the North, being unsuitable to the warm South. The ancients were also unacquainted with another use of the goose-feather, that of an instrument for writing. The first quill-pens were used at the commencement of the Middle Ages, in the time of the Ostrogoth Theodoric."[5]

CHANGES IN CAPTIVITY

The anatomical differences between the wild species and the modern domesticated breeds are not great. The walk has become a little more of a waddle, the ability to fly is lessened, the rump is deeper. The color pattern of the most widely known breed, the Toulouse, is very similar to that of the gray lag, but simpler. In general, the changes are those which would naturally be produced by selection of specimens which possessed the best marketable form.

The American Standard of Perfection recognizes the following breeds of geese: Toulouse (gray), Embden (white), African (gray), Chinese (both brown and white varieties), Wild or Canadian (gray) and Egyptian (colored).

Of these, the Toulouse seems to have been produced in France, which has long been celebrated for its geese, and the *paté de foie gras* produced from their livers. It owes its name to the city of Toulouse.

North German breeders, particularly in and around Westphalia, produced the Embden breed, by selecting white "sports" and breeding from them.

The African breed is of somewhat uncertain history. Though little different in appearance from the gray lag, it is said to be a hybrid between the Chinese goose, the Toulouse breed, and sometimes the Embden. The three preceding breeds comprise the heavyweight or market varieties, weighing from 17 to 25 pounds when properly fattened.

The Egyptian breed comes from an entirely different species (*Chenalopex aegyptiacus*), which has been of much importance to the domestic economy of that country ever since the beginning of history. It is gay in color as compared with the sober descendants of the gray lag.

The Wild or Canadian goose is the domesticated Brant (*Branta canadensis*) well-known to most North Americans. It is easily tamed, but has little commercial importance as a domesticated breed.

The Chinese goose is still another species (*Cygnopsis cygnoides*), an ornamental fowl which lays well and furnishes a good quality of meat. It weighs from 10 to 14 pounds, and is therefore the largest of all wild geese. Although not so well known in the United States as the European breeds, it is yearly becoming more popular and deserves to be widely kept.

All these species can be interbred freely in captivity.

[5] The two preceding paragraphs are from Victor Hehn, The Wanderings of Plants and Animals from their first Home; ed. by J. S. Stallybrass, London, 1888.

MOUTH PARTS OF THE HONEY-BEE

The outermost pair of organs are the maxillæ; the three in the center make up the labium. The long, central organ is the tongue, covered with long hairs, and terminating in a small, spoon-shaped lobe. The tongue is not a solid appendage, nor yet is it truly tubular, having an opening on its lower side; its cross-section is much like that of the casing of an automobile tire. Liquids rise in the tongue by capillarity and sucking; but when the bee is drinking rapidly from a considerable quantity of nectar, he brings close together all the five organs here shown, and they form a loose tube up which he can suck the fluid. This photo-micrograph by Dr. K. Brunnich represents the proboscis of a worker, the drone and queen having mouth-parts of much smaller size. Reproduced from Gleanings in Bee Culture. (Fig. 14.)

The following answer was given to an inquiry about breeding bees for greater length of tongue, so that they could pasture on red clover, which is ordinarily visited only by bumble-bees:

"Some ten years ago we discovered that we had one colony of bees that would work on red clover when it was in full bloom when all the other bees apparently were doing nothing. An investigation showed that the tongues of bees of this particular colony were considerably longer than the tongues of ordinarily normal bees. The tongue reach of the ordinary bee is between 16/100 and 17/100 of an inch long, while the tongue reach of these red clover bees we found to be 23/100 and 24/100 of an inch. Not much wonder then, that these bees were able to gather honey from red clover, which has very deep corolla tubes, when the other bees could not reach the nectar. We entered into some correspondence with the experiment station, suggesting that if they could shorten the length of the corolla tubes of red clover by careful selection we would make an effort on the other hand to increase the tongue length of our ordinary hive bees. But the effort on our part did not succeed for the simple reason that bees find their mates in the air and we could not control the male parentage. The result was that this particular sport of bees degenerated back to the original normal stock. This is as far as we have ever been able to go, and it was merely an accident that we secured bees of this tongue reach."

E. R. Root, Medina, Ohio.

Food Plants of American Indians

A new and interesting development of American horticulture is the study of crops grown by the American Indians. They have yielded some races of great value, among which one of the best known is the Tepary bean, exploited by the Arizona Experiment Station. This is highly drought-resistant; the present races are found to be much mixed, however, and are now undergoing selection, for the isolation of pure strains. In a similar way, a new variety of sweet corn has been isolated from a mixed lot of ears furnished by the Papago Indians, and is being submitted to careful treatment, which in four years has resulted in doubling the average size of the ear and increasing the yield. This variety promises to be of much value in semi-arid climates.

Eugenics on the Farm

Eugenics is given the first place in the declaration of principles of the Farmers' National Congress, written by Secretary O. D. Hill. It is declared to be the "paramount question of the century." "The American farmer, as a rule, takes great pride in improving his live stock," Mr. Hill says, "but never once seeks to improve the coming generations of his own household." It is urged that this question be kept constantly in the foreground, until it becomes a fixed principle of government.

Tobacco Hybridization

Careful analysis of tobacco hybrids, from a purely genetic point of view, is being made at the University of California; one of the objects is to find just how hybrids can be "fixed" to breed true. The tabulation of more than 10,000 measurements in the study of flower size furnishes as large a mass of data upon the inheritance of a quantitative character in plant hybrids as has been reported in genetics literature up to the present time.

A NEW TYPE OF CATTLE FOR ALASKA

No breeds of dairy or beef cattle have as yet been found hardy enough to stand the winters in the interior of Alaska without excessive expense for food and protection against cold. As a result milk sells for 50 cents a quart and the beef that is consumed in the country consists almost wholly of cold-storage meat brought from the outside, although occasionally a herd of steers is driven in from the coast, the trip to Fairbanks taking a month or six weeks. To remedy this situation as far as possible, the Alaska Experiment Station have undertaken to cross Galloway cattle with the Yak, an Asiatic ox much used by Mongolians, Tibetans, etc., for milk and meat as well as work. It is extremely hardy, pastures through the winter under the open sky in Siberia and obtains feed from last year's dead grass dug from under the snow. Crosses of the Yak and ordinary domestic cattle are common in parts of Asia

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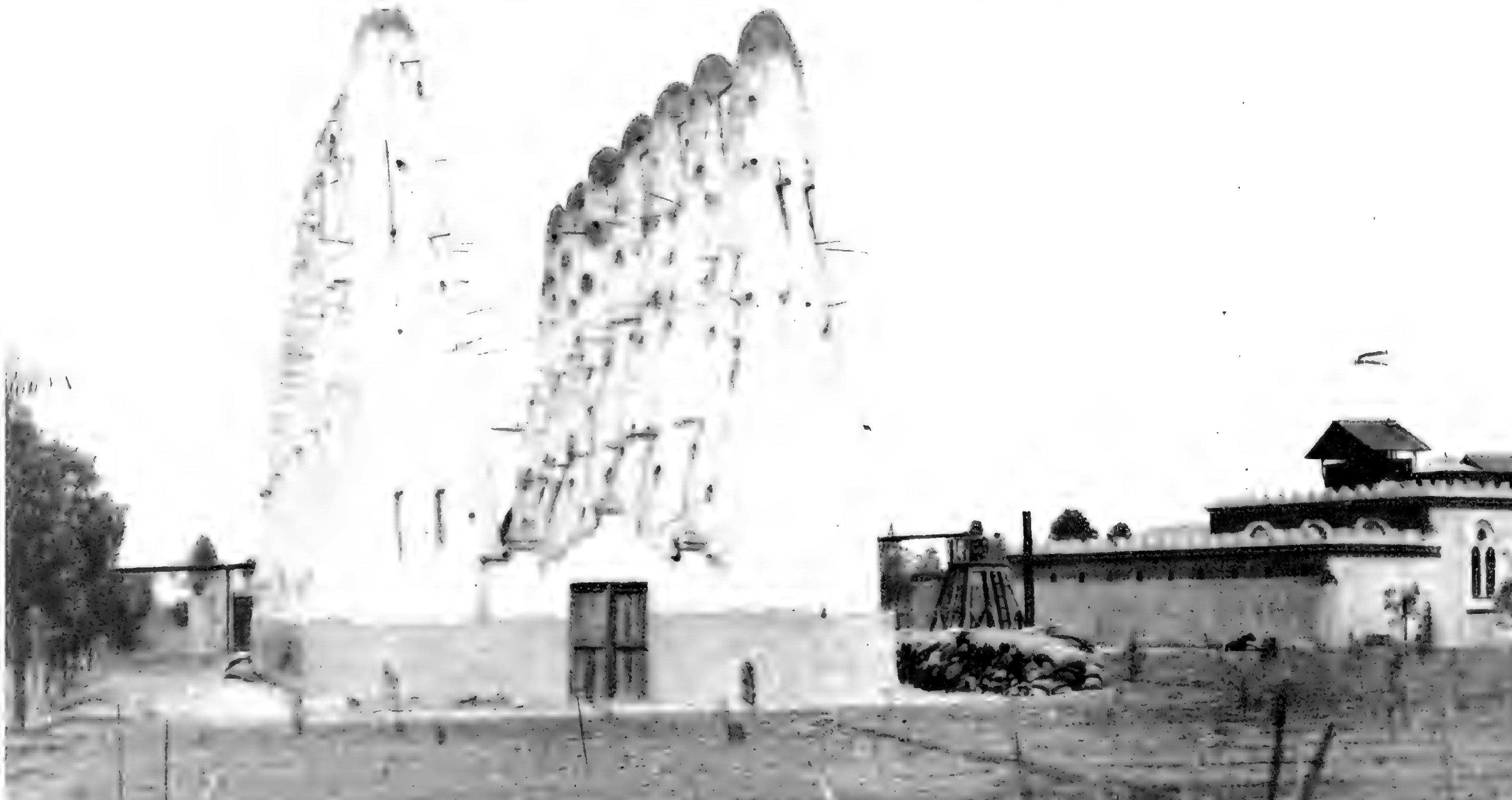
PIGEON BREEDING IN EGYPT.



Pigeon-breeding is an important industry in Egypt, and nowhere is it carried on more systematically than on the Beyerle estate, whose "pigeonry" is here shown. It consists of fourteen towers, each of which is made from 1,200 clay jars, laid in tiers with their openings inward. This arrangement makes it extremely easy to collect the manure, which is almost as valuable a product as the squabs. Mr. Beyerle started with 250 pairs of semi-wild pigeons, which he considered to be more fecund than the domestic breeds, and in a few years had 8,000 pairs in these towers, which, in addition to squabs, produced nearly 250 bushels of guano a year. Photograph by David Fairchild. (Frontispiece.)

BRIGHAM YOUNG

AN ILLUSTRATION OF PREPOTENCY

IT IS an axiom of heredity that the child inherits equally from his two parents; yet every observant person realizes that this is merely a general law, of a statistical nature, and that it does not always hold good in individual cases.

Sometimes one parent contributes much more than the other, as far as distinguishable characters are concerned. We then say that that parent is prepotent.

The idea of prepotency is particularly familiar to breeders of livestock, but few of them can explain it clearly, and the professional geneticist has so far met with little better success. It remains one of the most obscure things in the study of heredity, and some of the most plausible explanations of it are so hypothetical that it is almost impossible that their correctness should ever be proved.

But of the existence of the fact, no one can doubt. In the human species, every one can cite instances where all the children of a family "take" strongly after their father, or their mother, as the case may be. But never, perhaps, was the phenomenon of prepotency more graphically shown in man than in the accompanying photograph of eleven daughters of Brigham Young, by eight different wives.

"How different their mothers were," writes a member of this association who is well acquainted with the family. "But all the daughters are distinctly 'Youngs' in feature, voice, appearance and temperament. All are musical. All are amiable. All are adaptable, genuine, sincere, temperamental yet reasonable, and are good mimics. All are warm-hearted, generous, excellent cooks and housewives, and have the reputation of being attractive, magnetic and sympathetic. None is great as their father was great, but all are Youngs."

While many of these characteristics might be ascribed to similarity in training, one can hardly credit education with having influenced the shape of the mouth and nose. These features, however, in the daughters almost without exception, bear a very close resemblance to the corresponding features of the father. Certainly the strong, firm mouth of Brigham Young is reproduced in a most striking way. In general, it will probably be agreed that these children of a single father and eight different mothers show as much resemblance to each other as one often finds in the children of one father and mother.

MAJOR POND'S EXPERIENCE

An amusing incident connected with the likeness, which is so marked in Brigham Young's descendants, was that told very frequently by Major James B. Pond. He was always convinced that he could tell a descendant of Brigham Young, especially the girls, whenever he saw one and as an illustration he would tell of a certain time when he and a friend were walking on the streets of Seattle and he saw two young girls coming towards them.

Said Major: "Those girls are Brigham Young's daughters."

"Nonsense," replied his companion.

"Yes, they are," persisted the Major. "Will you wager with me?" he added.

"Yes," said his friend; "I will bet you $25 that they are not."

"Done," cried the Major.

As they met the girls the Major lifted his hat and said in his own courteous way: "Excuse me; this is a long way from Utah, but are you daughters of Brigham Young?"

The girls laughed and replied: "We are his granddaughters, through his eldest son, Brigham; but how did you know that?" The Major had earned his $25. People in Utah say that the

BRIGHAM YOUNG

He was of old Puritan stock, and although not all his ancestors have been traced, it is believed that he was of exclusively English descent—a belief that is borne out by his appearance. The first ancestor of record in America is William Young, who appeared in Boston and New Hampshire in 1721; but after him the Young family lived in Hopkinton, Mass. This photograph, taken only a few years before the death of Mr. Young, is considered by his family to be the best existent likeness of him. (Fig. 2.)

ELEVEN DAUGHTERS OF BRIGHAM YOUNG BY EIGHT DIFFERENT MOTHERS

Although coming from eight different mothers, the eleven daughters of Brigham Young shown above all have to a remarkable degree the facial traits of their father. The individuals shown are as follows (reading from left to right):

Top Row.—(1) Mrs. Myra Young-Rossiter, daughter of Lucy Decker, who was dark, short, and very stout, a woman of "American Dutch" family; (2) Mrs. Josephine Young-Young, daughter of Emily Partridge, who was tall, slender, and of dark complexion, a Yankee; (3) Mrs. Susa Young-Gates, daughter of Lucy Bigelow, of Massachusetts; (4) Mrs. Phoebe Young-Beatie, daughter of Clara Chase, of the New York Ross family.

Middle Row.—(1) Mrs. Zina Young-Card, daughter of Zina D. Huntington, thin, and with prominent features, a Yankee; (2) Mrs. Emily Young-Clawson, daughter of Emily Partridge, Yankee, and a full sister of No. 2 in the top row; (3) Mrs. Luna Young-Thatcher, daughter of Mary Ann Angel, a Yankee; (4) Mrs. Maria Young-Dougall, full sister of No. 4 in the top row.

Bottom Row.—(1) Mrs. Ruth Young-Healy, daughter of Emmeline Free, a Yankee; (2) Mrs. Clarissa Young-Spencer, full sister to Myra, who is shown in the upper left-hand corner of the photograph; (3) Mrs. Janet Young-Easton, Daughter of Clara Decker, also dark, very short, and stout, who was a sister of Lucy Decker.

From a photograph furnished by Mrs. Susa Young-Gates, Salt Lake City, Utah. (Fig. 1.)

truth holds pretty good even to the latest generation, especially with the girls.

Brigham Young, who was born in Vermont in 1801, was the second president of the Church of Jesus Christ of Latter-Day Saints, and in the opinion of all its members was second only to its founder, the Prophet Joseph Smith, as an organizer and statesman. He led the people to Utah and governed them for more than forty years, until his death in 1877. In accordance with the early doctrine of his church, he had nineteen wives, ten of whom were mothers of his children. The others were widows to whom he gave a home and protection.

If the children of these different wives had inherited equally from their mother and father, there would have been a considerable diversity among them. Why is it that there is so little variation among them; why is it that the father "stamped his impress" on them so uniformly?

When we answer that it is evidently a case of prepotency of the father, we only postpone the real explanation one step further; for prepotency is a term that probably covers half a dozen different things. It often results from consanguineous marriage, but there is no evidence that such matings occurred in the ancestry of Brigham Young. It may also be promoted by assortative mating—"like with like"—and it is possible that marriages of that sort had taken place in the Young family, although the data extant do not suffice to make this point plain. It may also be due, according to present ideas, to a mere chance presence of a large number of dominant traits in one individual.

VALUE OF PREPOTENCY

Whatever its origin, prepotency is a factor of great importance to the geneticist, and the ability to control it and depend on it would be of great value to the science. This is as true of eugenics as of any other branch of genetics; for it is obvious that if we could establish stocks highly prepotent in some desirable character, it would be distinctly to the advantage of the race.

The subject of prepotency, therefore, deserves careful investigation by the eugenicist, and for reasons stated above it appears to the writer that no material available offers such advantages as do the genealogies of the Mormon families. Aside from the fundamental advantage of offering data about the offspring of a single husband and several wives, it has the further important element of fullness and accuracy, for the Mormons are among the most industrious and careful of genealogists. As it is for them a duty to work for the eternal happiness of one's ancestors, and as these ancestors must be known, if intercession is to be made for them, it results that every Mormon takes a practical interest in genealogy, and among the women of the church particularly, familiarity with genealogical methods is probably more widespread than among any other class of people in the United States.

The research worker, therefore, finds ready to hand among the Latter-Day Saints a large body of material of extraordinary value, which has as yet scarcely been touched for the purposes of biological research. It seems probable that the proper use of this material would advance research in human heredity more rapidly than will any other American genealogical data available to the student; and among the important problems on which light would be thrown is certainly the problem of prepotency, which is so strikingly illustrated in the accompanying photograph of Brigham Young and his children.

THE PERSIAN WALNUT

A Typical Problem in Tree Breeding—Great Improvement in the Past Due to Unconscious Selection and Chance Hybridization—Much Greater Progress Possible in Future, Through Intelligent Methods.

J. Russell Smith

Professor of Industry, University of Pennsylvania, Philadelphia, Pa.

ONE of the most significant statements I know in connection with the whole matter of agricultural extension on the production side is the following from C. S. Sargent, in connection with the Persian[1] walnut (*Juglans regia*).

> "The nut of the wild tree is small, with a thick hard shell, and small kernel, and is scarcely edible, but centuries of cultivation and careful selection have produced a number of forms with variously shaped thin shells, which are propagated by grafting and budding." (Silva, Vol. VII, p. 115.)

To persons familiar with the big, sweet, nutritious nuts now so common in the world's market, it is indeed difficult to believe this statement as to their original unpromising condition. This improvement appears to have come by chance breeding which has given a splendid tree crop for the Mediterranean climate where it seems to have originated, and it has also given a most stimulating object lesson of the means by which we may duplicate the process in walnuts of several species and *for scores of other trees* that are not now crops at all. The method by which the magnificent Franquette or Mayette walnuts have come out of the mean parentage described by Sargent is *probably* as follows:

Centuries ago, perhaps dozens of centuries ago, people in southern Europe and western Asia carried home the seed of wild walnut trees from the woods as we do now with black walnuts, chestnuts, hickories, hazels and other wild nuts. They planted of the best in their gardens. This may properly be called a selection of one in hundreds. Of the resulting seedling most were certainly poor trees from the horticultural standpoint, but one out of a hundred was likely to be good, perhaps better than the parent. From what we know of human nature wrestling with the problem of stomach-filling, this best tree became the parent of the next generation of seedling walnuts in that valley or the next valley—again a selection of one in a hundred. We now have the hundredth tree from the hundredth tree. This may easily have been repeated ten, twenty, or even fifty or more times. The best seedling walnuts of today thus represent the selection from among a vast number of seedlings.

SELECTION IN BOTH SEXES

But hold—this is not all. These seedlings have not been yielded by extra good females fertilized by *average* males. The collections of seedlings from selected seed have often given chances for the crossing of *two selected strains*. To all intents and purposes we have had practical walnut breeding going on—but

[1] The name "walnut" means merely "the foreign nut," and was given by the early English because the nut came from abroad. The name "English walnut," under which the Persian walnut passes commercially in America, is due to the fac tthat many of the nuts were transshipped to this country in England; but as it is an absolute misnomer, the name "Persian walnut" is now generally used among growers.

we have been going it blind. Now we can go at it with our eyes open. If by chance we have in unknown centuries turned a small nut "with a thick hard shell and small kernel, scarcely edible" into the splendid one for which we pay 25 or 30 cents per pound, what may we do if we use our known powers of cross breeding and hybridizing? Is it not reasonable for us now to expect to be able to produce as great changes in twenty-five or fifty years as chance has done for us in twenty-five or fifty centuries?

The Persian walnut, this golden gift of chance breeding, is a grossly neglected agent.

This nut is great in its economic significance, for the future, and considering its possibilities it is equally great in its agricultural insignificance in the present. Its food value places it very high among foods, because of its high percentage of meat in comparison to waste, and its combination of food elements, furnishing as it does the costly protein and the much coveted fat. Further than this, the tree produces one of the most valuable of woods.

In operation it shows up as a veritable engine of food production, a single good tree in France commonly yielding as many pounds of human food per year as is given by the meat produced by an acre of pasture in England. Of the two foods the walnut is more nutritious by the ratio of 2 to 1. Grafted trees of the Mayette and other varieties scattered about the fields of France have been making these heavy yields for many decades.

The range of the tree serves to emphasize the unrealized possibilities. The Persian walnut with these wonderful qualities of heavy yield of rich food and good wood is at home in a wide belt which encircles the globe in both hemispheres. The tree is actually found all through the Mediterranean region of Europe, in Asia Minor, Central Asia, China, and Japan, in Pacific America and in the Eastern United States from Georgia to Ontario. It also grows in the South Temperate zone. It has been known from ancient times, and yet it has been developed as a crop only in a few areas, as in Southern France, Italy (near Naples), California (chiefly near Los Angeles), and the Orient. I doubt if there is a 10-acre orchard of grafted walnut trees under one management in all Europe. I have been in all the leading districts and found none so large, merely little patches and scattered trees.

IN EASTERN AMERICA

In the eastern United States there have been scattered trees producing good crops for many years. Trees of local repute have recently been reported from Ontario, Michigan, New York, New Jersey, Pennsylvania, Maryland and Georgia. Some of them are of great size and over a century old.[2] Some of these trees are reported to be practically annual bearers, yet thus far the nut has strangely failed in becoming the basis of a regular crop in the eastern United States. This fact has had two causes, chief of which is the past dependence upon seedlings, which are indefinitely variable, and in the eastern United States mostly worthless, because of unacclimated seed; and its great susceptibility to frost, due to its early blossoming. These causes have resulted in the failure of numerous commercial attempts dependent upon seedlings.

As an instance of this I will cite my own ill-guided experience. In 1896 I planted two acres in northern Virginia of the best seedling Persian walnut trees I could then secure from a New Jersey nursery. They were 3 to 4 feet high. The next year they were 2½ feet high, the next year they were 1½ feet high. Then they began gradually to disappear. The last one lingered until 1912, when a temperature of 25° F. snuffed out its worthless and despairing life. It grew in a magnificent, rich spot and attained the height of 9 feet. Most of the new growth winter-killed annually and it never bore a nut. There were no grafted trees to be had at that time and

[2] See reports of Northern Nut Growers' Association, 1912-1913, Dr. W. C. Deming, Secretary, Georgetown, Conn.

it was reported, even I believe by the United States Government, and believed everywhere, that they could not be grafted or budded.

This benighted condition of a possible industry is hard to believe when we stop to think of the fact that the grafting and budding of these trees has been going steadily on in the vicinity of Grenoble, France, for generations. There lived that pioneer nut culturist, Mayette, who propagated the variety that bears his name. In this district top worked trees have been for sale almost any year since before steamships started across the Atlantic. And yet so far as I know this might just as well have been in the moon for all the good it did us until California started the walnut industry. The grafted Mayettes of the stock of Grenoble are now proving hardy in Pennsylvania and Connecticut and if the kind used in the Grenoble district (Persian on Persian) had proved unsatisfactory there apparently would have been little difficulty in getting Grenoble nurserymen to raise American black for us and to graft it to anything we favored. Fortunately, however, we do not have to go into any such heroics now to get the trees.

GRAFTING THE TREES

We now know how to graft and bud this tree right here in the eastern United States and put it upon the more vigorous roots of the native black walnut. As to the technique of this newly-won process, there are four points for the ordinary apple or pear grafter to keep in mind, and the same also apply to the grafting of the hickory genus which offers, in almost every respect, problems like those of the walnut genus. These four points are: (1) Keep the cions from drying out by waxing entirely or by binding a paper bag over the stock and cion; (2) Do not split the pithy cions, avoid this by trimming wedge grafts so that one of the cuts goes clear across the pith; or use the slip bark method which has all the cut on one side; (3) Graft or bud when the tree is in rapid growth; (4) Use well ripened, well developed wood cut early in the winter. Two-year-old wood seems to be better than one-year-old wood and California grown wood has shown itself superior to eastern grown wood. It is quite possible that we will shortly begin to send cions of desirable eastern trees to California to have budding and grafting wood grown for eastern use.

In budding, the patch bud and wing bud methods are the only ones that have shown themselves worth while. The experience of the years 1914–1915 seems to indicate that this budding may be done early in the spring with wood from cold storage and forced into immediate growth by cutting off other growth. For photographs and details important to the experimenter see bulletin on the walnut by United States Department of Agriculture and the reports of the Northern Nut Growers Association, W. C. Deming, Secretary Georgetown, Connecticut. I am having lots of fun from the two dozen nut trees I have grafted and budded.

SELECTION OF PARENTS

The discovery of these new arts of propagation serves instantly and acutely to emphasize the question, What *parent trees* shall be used in propagation? Only a fraction of the eastern trees have been examined carefully, and it is perhaps true that none has yet been found in the Eastern United States with fruit of the high quality of the best European varieties. In addition to the great variation in the quality of nuts, there is great variation in the adjustment of the trees to the climate. This makes a careful survey of the existing and widely scattered thousands of Persian walnut trees in the United States a very promising prospect. Here is also a problem in *tree breeding*, rich with possibilities. The great variation within the species and the easy and wide range of its hybridization with other species would indicate that it has great possibilities in the hands of the plant breeder.

An interesting example of the ease of its hybridization is furnished by a New Jersey farmer near Camden. He has three or four fine and very productive Persian walnut trees. He was so pleased

THE ORIGIN OF A VALUABLE VARIETY

This Persian walnut tree is growing on Pequea Creek in Lancaster County, Pa., and was discovered some years ago by a man interested in nut-growing in the Eastern United States, who realized that this tree was worthy of propagation. It is supposed to be fifty years old, and bears two or three bushels of early-maturing nuts in a good year. Nothing is known of its parentage, but it is undoubtedly a seedling, which happens to bear nuts of good quality, and to stand a great deal of cold weather. It was made the foundation of a new variety, which was given the name of Nebo, and which is now being disseminated and is helping to make the culture of the Persian walnut possible in regions where it was formerly supposed that the climate was unsuitable. Photograph from the U. S. Department of Agriculture. (Fig. 5.

with them that he planted one hundred more, seedlings from a nursery, foolishly thinking them all much alike. The new trees grew finely, showing the Persian type of foliage. When they bore, it was such a collection of long rough nuts of evident butternut (*Juglans cinerea*) paternity that the farmer dug up all of the trees but one, which bears a nut of apparent hybrid form and little value.

Experiments of Dr. Robert T. Morris and others have shown that there is great freedom of hybridization between the various species of walnut. Some hybridization is possible between the walnuts and hickories. So common is the cross between the Persian and the Black in California that it is a recognized kind called Royal, distinguished as are many hybrids for astounding vigor of growth. This is offset by a poor yielding power but Professor Smith, of the University of California, reports *one* (see bulletin on walnut blight, 1912) that is a good bearer. That *one* tree is exceedingly significant. It would seem to indicate that others like it can be produced—fruitful and growing with the fury of a weed. This is merely one of the many breeding problems which the walnut alone holds out to us now that we know how to breed plants.

A MARYLAND SPECIMEN

A peculiarly promising tree as a breeding parent, is one that has been found in Maryland about eighteen miles north of Washington, D. C. If the nut had a little less bitter on its skin, the tree would be an almost ideal parent. It is reported to have borne twelve or thirteen consecutive crops. This is unusual for any fruiting tree. Rumors to the contrary, consecutive cropping of fruit and nut trees is not common except in the form of a heavy and a light crop alternating. Unfortunately I cannot give exact measurements for the yield of this Maryland tree. Its regular record is probably due in large part to its late habit of spring growth. Whereas most of the Persian walnuts send out their leaves with the earliest approaches of spring and lose their blossoms and often their foliage and twigs with frost, as does the apricot, this tree remains dormant until June, then grows with great rapidity and matures its crop. In Grenoble, France, I saw on the 10th of June, 1913, when farmers were making hay, some Persian walnut trees just showing the first green of their buds at the same time that cherries were ripe on an adjacent tree. I should have passed these trees by except that I asked my companion, Vice Consul Murton, a master of the local walnut situation, why the leafless trees had died. Although permitted to live, these trees were not particularly prized by the French walnut growers, because they were reported to bear scanty crops, although the nuts were reported of satisfactory quality. The bringing together of these two late strains, one of good bearing habit and fair quality, the other of excellent quality and both of wonderful frost resisting ability would seem to have great promise as a breeding experiment.

I called these facts to the attention of E. R. Lake, of the Pomological staff of the United States Department of Agriculture, and asked him who in the United States was in a position to conduct these experiments. After a moment's pause he said, "I guess you will have to go to J. W. Killen, of Felton, Delaware." I happen to know that Mr. Killen is a farmer of an experimental turn of mind, willing to work and sacrifice time and money for the advance of agricultural knowledge. I regard it as little short of lamentable that so great a problem as the breeding of a new tree crop of the importance and promise of the Persian walnut should, in the United States of America, be dependent wholly upon the unpaid and unsupported enthusiasm of a private individual. We need at once a thorough search for the best among the hundreds of possible parent trees in the East. Mr. Fagan, of Penn State College, made such a survey of his state in the summer of 1915 and found about 5,000 Persian walnut trees which are now under observation. They need testing out with regard to their behavior under cultivation, their resistance to the Cali-

fornia walnut blight, and numerous experiments in cross breeding and hybridization should be made to develop the good parent trees which we now have reason to believe can be produced by the breeding from many of the promising trees already known to us.

THE PROBLEM OF TREE CROPS

If chance hybridization and selection in the past has brought the worthless wild tree described by Sargent to the present perfection of the commercial Persian walnut, we certainly have great reason to anticipate large results from systematic hybridization if we can focus the resources of constructive science in that direction.

The Persian walnut is but a type in the whole tree crop question. Its typical aspects may be summarized as follows:

1. As a crop producer it is almost worthless in its wild state.
2. Some trees usually widely scattered are much superior to the average and worthy of propagation.
3. Cross-bred strains from selected rare trees are much superior to any wild tree (such have been produced in the gardens of Mediterranean lands).
4. The possibilities of better varieties by hybridization have merely been glimpsed, not realized, and demand immediate work.

The plant kingdom has never been systematically searched for useful plants. This is particularly true of trees, from which we have held back because of the time element; yet there is little doubt that forty or fifty species of wild trees are quite as promising of a good agricultural crop as was the wild walnut described by Sargent. By selection, propagation, cross-breeding and hybridization, each of the fifty or more can probably, like the walnut, be made into a valuable crop producing food for men, and what is more important, agriculturally, food for the beasts, if the problem is systematically handled. This field of endeavor also promises one of the most potent cures for the erosion problem. The hillside whose soil is pinned to the bed rock by the interlacing roots of crop yielding trees will not erode. It will stay and pay.

Breeding Native Grapes

Valuable work on self-sterility has been done at the North Carolina Experiment Station, principally with native grapes, but to a less extent with persimmons, blackberries and dewberries. It is found that the latter berries are in some cases self-sterile and in some cases self-fertile; grapes of the muscadine type (*Vitis rotundifolia*), however, have proved to be self-sterile in almost every instance. It is therefore necessary that the grower of such grapes should plant enough male vines to furnish pollen; and it has been found that there are two distinct wild types of male vine, the commoner one producing grapes that, when further propagated by seed, yield dark-colored fruit, while a rarer type, when perpetuated, yields light-colored fruit. All scuppernong grapes of the immediate generation are light colored. By the growth of several thousand hybrid seedlings, an effort is being made to find whether such characters as color of berry, persistance of holding fruit and size of fruit and size of fruit clusters are transmitted, and if so, by what laws.

In this connection it will be of interest to mention that the United States Department of Agriculture is engaged in breeding a strain of muscadine grapes with perfect flowers, starting with a single individual of this character which was found among a lot of seedlings. The project promises to be wholly successful, and will make the production of these grapes much more profitable. Hybridization is also being used to produce varieties of grapes that will combine the vigor and disease-resistance of the *Vitis rotundifolia* and its large berries, with the hardiness and large clusters of the northeastern United States species (*Vitis labrusca*, etc.).

PROBLEMS IN WALNUT BREEDING

The Industry in California Being Transformed Through Propagation of Grafted Trees—Walnut Blight and the Variability of the Present Groves—the Ideal Commercial Nut[1]

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THE walnut industry of California is just entering a transition period, from the planting of seedling groves to the establishment of plantings composed of grafted trees. Just as other seedling fruit trees, such as the orange, apple, peach, almond, etc., have been eliminated, so, too, the seedling walnut groves of California seem doomed to be replaced by clonal varieties. In many ways this industry is as much in its infancy as the apple industry of New York was sixty-five years ago, when varieties first began to be propagated in a commercial way by grafting and budding. This readjustment in the walnut industry is well started, and although it is likely to be gradual in its evolution, and wisely so, the change seems nevertheless certain. There are but a very few seedling trees for sale at the present time by the progressive nurseries, and in fact only a very few such trees have been set out in groves during the past four or five years. This demand for a grafted tree has been brought about largely by the wide range of variation in walnut seedlings, as regards their productivity, commercial value, season of harvest and ability to resist the walnut blight.

With this very recent propagation of the walnut by grafting, which has extended over only ten or twelve years, it is reasonable to expect that the majority of the varieties thus propagated so early in the development of this industry are only partly suited to the needs of the walnut grower. The nuts from many of these grafted varieties fall considerably short of the commercial standard for high-grade walnuts. Some of the heaviest-bearing sorts, such as the Chase, Prolific and El Monte, produce nuts which cannot be sold in the very best grade of the commercial product. On the other hand the Placentia, which produces the most nearly ideal commercial nut, is not a heavy-producing variety, especially in the northern walnut sections, and is quite as susceptible to walnut blight as the average seedling tree. Again, the Eureka variety, which seems successfully to avoid the walnut blight during many seasons by its lateness in coming into bloom, is a very moderate yielding sort in the southern sections. The above examples are only a few of many which might be cited to show the shortcomings of most of the varieties of walnuts now being propagated.

MANY VARIETIES NEEDED

The wide range of climatic and soil conditions makes the eventual propagation of quite a large number of varieties inevitable. While the coast regions are bathed in fog nearly every morning during the growing season, the inland valleys experience an extremely dry climate with high maximum temperatures. Walnuts are being grown at the present time on soil types varying from the extremes of sand to heavy clay loams. Many of the future varieties must be especially adapted to some one of these particular environments if they are to withstand the test of time.

Many of the present seedling groves are of uncertain origin and represent greatly varying values. No doubt some

[1] Read before the twelfth annual meeting of the American Genetic Association, at Berkeley, Cal., August 5, 1915.

of these groves are the progeny of especially selected trees known to have considerable merit. On the other hand, it is very apparent that many of them are the result of a great demand for seedling trees when this industry was in its infancy twenty or thirty years ago. At that time great quantities of walnuts were planted without due regard for their parentage. Again, there is a wide range of variability among the individual trees of any grove, as variations in type of tree, blooming season, character of foliage, resistance to disease, productivity and character of the nuts.

Type of Tree.—The tree types vary from the upright sturdy individual to the more or less spreading, weeping types, which droop nearly to the ground under the burden of their crop. The upright, vigorous growing type is well exemplified in the Eureka. On the other hand such varieties as the Prolific have a spreading, bushy habit, and an almost semi-dwarfness characterizes their growth.

Blooming Season.—It is not unusual to find the blooming season in an ordinary seedling grove extending over a period of from a month to six weeks. A few individual trees leaf out and blossom with the first signs of spring. Then quite the larger part of the grove comes out in full leaf, while there are frequently trees which are still bare after the nuts on the early individuals are of the size of a marble. This variation in the blooming season has considerable economic importance in relation to the harvesting and marketing of the nuts as well as the avoidance of diseases and frost which may be more prevalent during certain periods in the spring.

MANY TREES UNPROFITABLE

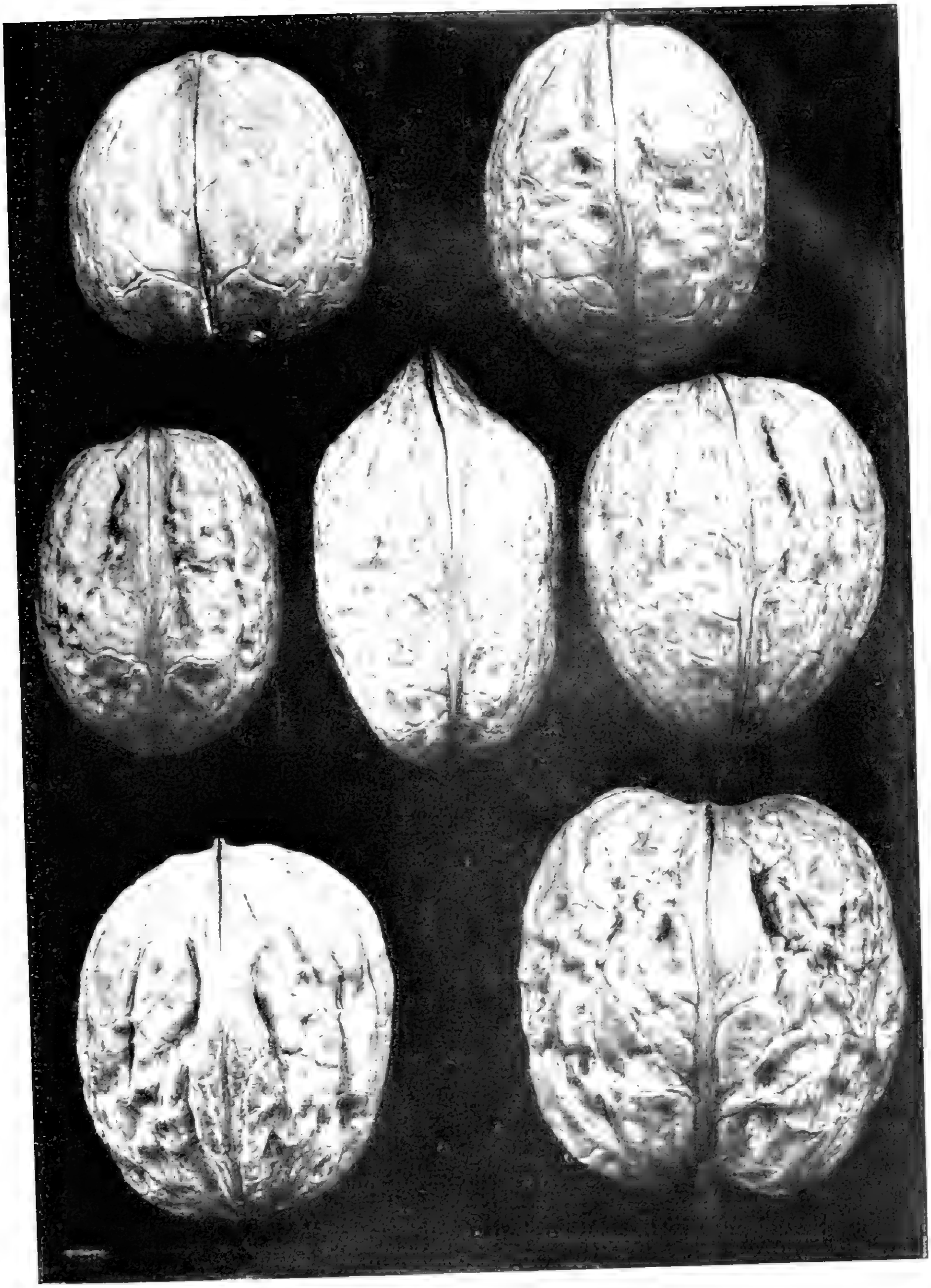
Variation in Productivity.—Some of the old experienced walnut growers feel that 25% of their seedling trees are unprofitable, another 25% are barely paying expenses, and that the profit is really derived from about 50% of the trees. The variations in seedling trees is well shown by Smith[2] in summarizing the results of certain fertilizer tests; he found that twenty trees in a given row varied in productivity as follows: Number of pounds produced by each tree, 1, 16, 45, 10, 21, 97, 20, 8, 26, 0, 16, 1, 18, 13, 10, 21, 2, 31, 7, 14. This is only a fair example of the variation in the large majority of seedling groves. The above figures are from a young grove and should not be considered as typical of the total production for twenty mature walnut trees.

Foliage Characters.—The character of the foliage varies from the broad-leaved types, in which case the foliage somewhat resembles that of the horse-chestnut, to the narrow-leaved varieties whose leaves have a tendency to curl up like the foliage of the Winesap apple. The broad-leaved types are much more densely foliated and this factor has considerable bearing on the problems of sun-scald on the twigs and trunks of the tree and the exposure of the nuts to this malady. For this reason, the densely foliated varieties may prove best adapted to the inland valleys, where the difficulties of sun-scald are most prevalent. The more sparsely foliated sorts often appear to have less blight on the nuts and leaves, because of their exposure to the sunshine.

Disease Resistance.—Probably one of the most important limiting factors to walnut production in California, and especially in the older walnut sections, is the bacterial disease commonly known as walnut blight. The inroads of this disease have caused a very heavy dropping of the nuts during many seasons of the past, and although a great deal of time and scientific effort have been devoted to the control of this trouble, there is no known means for the prevention of walnut blight at the present time.

The great variation among seedling trees in regard to their susceptibility to blight is indeed a hopeful sign for the eventual production of varieties which will more or less resist this malady. Among 105 trees in an orchard under observation in Orange County, the percentage of diseased nuts on the individual trees before any dropping had

[2] Calif. Bull. 231, p. 187, 1912.



COMMON TYPES OF WALNUT IN CALIFORNIA

The Persian (commonly called English) walnut is widely grown in California, but as the early groves were all planted from seed, there are [illegible] great many different types of nuts produced. This illustration shows the wide variation among these types. Efforts are now being made to organize the industry on a broader base, by eliminating the worthless types, and introducing new ones [illegible] as [illegible] many good points as possible. (Fig. 4.)

YOUNG WALNUTS AFFLICTED WITH BLIGHT

The walnut industry of California has been seriously threatened by a bacterial disease, against which no remedy has yet been found. It has been discovered, however, that great differences exist among individual trees, in their resistance to this infection; and by propagating the most resistant trees, it is believed that groves can be created which will be practically immune to the disease. (Fig. 5.)

taken place, ranged from 6% to 95%, while the average amounted to 47.4%. These percentages are not given with the idea of expressing the exact amount of injury caused by this disease, as many nuts which are slightly blighted remain on the tree and may yield a commercial product. In calculating the extent of this disease, every nut which was blighted in the least was counted as diseased, and thus the comparisons are thought to be a fair indication of the variation of the blight on the individual trees, but not necessarily an estimate of the damage to the grove. From our present knowledge it is very apparent that the disease resistance of individual trees varies considerably from year to year and under different soil and climatic conditions. The thorough testing of resistant varieties will require considerable time.

Nut Characters.—The nuts are as variable as the trees themselves, not only in the exterior appearance but in the character of the meats as well. The ideal commercial nut should be of medium size, as 1⅛ to 1½ inches in diameter, of a regular oval form somewhat elongated, smooth surface, and light brown color, and uniform for these characters. The cracking quality of the nuts is quite as important as their exterior appearance. The nuts should be well sealed so they will not crack open in shipping. The shells should be thin but strong so the nut may be easily opened and the whole meat taken out intact. The pellicle should be light tan colored or silvery brown with a glossy waxed appearance attractive to the eye. The meat should be smooth, filled uniformly throughout the nut, averaging 50% or more of the total weight, and with a mild, pleasant

flavor free from any astringency. The shells vary from extremely rough and unattractive specimens to smooth commercial types, as the Placentia, while the color of the meats varies from dark brown to nearly white, and so on through the other characteristics mentioned.

In the selection of varieties, the walnut breeder is exceptionally favored by the occurrence of large areas of seedling trees. According to the 1910 census, there were in the neighborhood of one and a quarter million seedling trees growing in California. With this almost unlimited material for selective use, it seems indeed reasonable that many varieties will be selected in the future, which are better adapted to the demands of the industry than some of the walnuts now being propagated. By means of hybridizing methods, it is also hoped that some of the desirable unit characters of the sorts now in cultivation may be re-combined into more nearly ideal varieties for future generations.

Very little is known at present concerning the correlation of certain desirable or undesirable characters of the walnut. Work is under way at present by the Citrus Experiment Station in an endeavor to ascertain these relationships.

The fact that walnut breeding is necessarily a long-termed, expensive problem has made it rather unattractive to the practical breeders. Such work will depend largely upon public institutions for its support.

Plant Breeding at Cornell University

The plant breeding work at the Cornell University (New York) Experiment Station has given results of both economic and fundamental importance. Among the former are to be noted the production of high-yielding strains of cereals, potatoes, timothies, and so forth. For example, improved strains of oats have been found to yield from 9 to 14 bushels per acre more than the variety from which they were isolated. Two strains of dent corn mature about two weeks earlier than the variety from which they were produced and at the same time outyield somewhat the original variety. The superiority of some of the selected strains of timothy over ordinary timothy has been demonstrated. Hill selection of potatoes has been shown to be an effective method of producing high-yielding strains.

Of the more important fundamental results obtained from the Cornell Station's breeding work may be mentioned the following: Bud variation has been found to occur with no inconsiderable frequency in potatoes and has been demonstrated in clonally-propagated timothies. Results of importance not yet formulated for publication have been obtained through studies of seasonal and place variation in daisies, through selection within pure lines of cereals, through hybridization of oat and wheat varieties, and the like. Extensive studies in color inheritance in phlox, morning-glory, beans, corn, and so forth, are being prosecuted, the latter having been recently transferred from the Nebraska Station. Statistical studies of variation also constitute an important part of the plant breeding work at Cornell.

Altering the Galloway Breed of Cattle

At the Alaska experiment stations, Special Agent C. C. Georgeson writes: "We have made a beginning in the development of an all-purpose cow from the Galloway. Something more is needed in Alaska than the beef qualities, which are so characteristic of the Galloway. The Alaska settler wants a cow that will give milk, as well as produce beef and at the same time be hardy enough to withstand the climate. We expect to reach results by proper mating and selection. It is not contemplated at the present time to go outside of the breed to secure milking qualities, though, undoubtedly, results could be reached more quickly by crossing with some other breed, thereby sacrificing the purity of the stock. The Brown Swiss might make a good cross with the Galloway."

$1000 FOR DATA ON HEREDITY

MOST students of heredity today believe that the results of use and disuse are not inherited; that work done by the parent will not affect the inborn character of the offspring; in short, that "acquired characters" are not transmitted.

C. L. Redfield, a Chicago engineer, holds the opposite view. So strongly does he believe that the general opinion of biologists on this point is incorrect that he has offered the American Genetic Association $1,000 for evidence on the subject. This is to cover data on five points.

1. He will pay $200 for evidence that any one of the two or three thousand intellectually great men or women of history is the product of an ancestry which represents, on the average, four generations to a century.

2. He will pay $200 for evidence that any one of the two or three hundred intellectually *very* great men or women of history is the product of an ancestry which represents, on the average, three generations to a century.

3. He will pay $200 for a case from livestock breeding, where the parents made acquirements below the standard, in respect to performance, and the offspring surpassed the parents.

4. He will pay $200 for a case where a decline in powers of the offspring failed to follow acquirements, in the parents, which were clearly and distinctly below the standard of performance of the breed.

5. He will pay $200 if it can be shown for any group of animals that the amount of improvement or decline in animal powers was not, as nearly as can be determined by actual measurements, exactly proportional to the amount of acquirement by ancestors above or below the normal or standard.

The last three items require full pedigrees for three generations with measurements applied, with a fair degree of accuracy, to each parent in the pedigree. Mr. Redfield's publications give numerous examples of how measurements are made and applied to three generations of ancestors. The comparison is to be between the final product and the ancestors three generations previously.

Approved securities to the amount of $1,000 have been deposited by Mr. Redfield with the treasurer of this Association.

The first two items enumerated above are extensions of a proposal which Mr. Redfield has been making through this association for nearly two years. The result of the first year of the offer were stated in the JOURNAL OF HEREDITY for February, 1915 (Vol. VI, p. 92); half a dozen pedigrees were sent in, but none of them met the requirements.

TWO PEDIGREES SUBMITTED

During the past year only two pedigrees of interest have been sent in. Marshall Nevers, of 113 Columbia Heights, Brooklyn, N. Y., has pointed out that the ancestry of William the Conqueror covers about 100 years in three generations, while Dr. Heinrich C. Keidel, instructor in the German department of Ohio State University, has submitted the pedigree of Frederick the Great, showing that he, too, comes in the three-generations-to-a-century class.

It appears that the council of this association must undertake the somewhat unpleasant task of declaring whether or not, in its opinion, the intellectual greatness of either William or Frederick is sufficient to entitle him to a place among the two or three hundred intellectually most eminent men and women of history. At Mr. Redfield's suggestion, the consideration of this point is postponed and these two contributions will be submitted under the new and larger offer, to be decided upon at the end of the present year.

In the meantime, it is the hope of the council that genealogists may be able to uncover other great men who are the

product of several generations of early marriage. Data on this subject and the others brought up by Mr. Redfield are of real value to the study of heredity entirely apart from Mr. Redfield's own interpretation of them.

The other three items in Mr. Redfield's new offer should be of particular interest to the students in agricultural colleges, who have access, in many cases, to the necessary records, and could easily investigate the question whether performers of great merit have been produced in any other way than that indicated by Mr. Redfield. It may be of interest to refer to earlier investigations on this subject, particularly that of F. S. Putney[1] with the dairy herd record of Missouri Agricultural College, and that of F. R. Marshall[2] with the records of American trotting horses. Both these investigations were undertaken for the purpose of testing Mr. Redfield's theory of heredity, and both failed to satisfy their authors that that theory is correct.

Mr. Redfield, however, does not consider these two investigations conclusive. But as many breeds of live stock offer ample data on the point of record of parents and offspring, there should be no difficulty, with the inducement of Mr. Redfield's money offers, in getting abundant evidence on the question of whether or not great performers can come from poor or undeveloped performers. As Mr. Redfield says, the facts are capable of reasonably exact measurements in what he calls dynamic units"—that is, in units of work performed by parents before reproducing.

Here is Mr. Redfield's communication to the Journal of Heredity, with the details of his new offer:

MR. REDFIELD'S STATEMENT

"In April, 1914, I offered a reward of $200 for evidence that any mentally superior human being was ever produced by rapid breeding. The offer was divided into two parts in such a way as to make the degree of superiority directly dependent upon the rate of breeding. Thus, $100 was to be paid for any intellectually superior person produced by breeding at the rate of four generations to the century, and another $100 for any very superior person produced at the rate of three generations to the century, or faster. The details of the offer were published in the Journal of Heredity for July, 1914.

"The original offer expired December 31, 1914, and was later extended to December 31, 1915. I am now renewing the offer for the year 1916, and at the same time I am doubling the amount of the reward offered. The offer now is $200 for any superior person produced at the rate of four generations to the century, and another $200 for any very superior person produced at the rate of three generations to the century.

"In the above offer, rate of breeding means age of parents at time of reproduction, and age of parents means the inheritance of acquired characters, and means nothing else. The age of a parent at the time of reproduction is the coefficient of a variable, and extending it over three or four generations necessarily involves inheritance.

"If an acquired character is to be inherited, the parent must make the acquirement first and get the offspring afterwards, not get the offspring first and make the acquirement afterwards. The age of parents is simply one factor in determining the amount of a parent's acquirement at the time of reproducing.

"In my various publications from 1902 to 1914 I have pointed out that acquirements are dynamic in character and may be measured in dynamical units. I have also pointed out that when it comes to questions of mental or physical power in animals there must be a certain standard amount of acquirement per generation before reproduction to maintain any species, breed or family of animals on a level—that is,

[1] Annual Reports of American Breeders' Association, Vol. VI, pp. 310–317. Washington, D. C., 1910.

[2] American Naturalist, January, 1909.

keep it from degenerating in its power capabilities. In *Dynamic Evolution*[3] I have given detailed explanations of how acquirements are measured, how the standard for any group of animals is determined, and how comparisons are made. Also some peculiarities of the manner in which acquirements are transmitted to succeeding generations.

THREE GENERATIONS REQUIRED

"I now make an additional money offer for contrary evidence bearing on this matter, the understanding being that measurements must be in dynamical units, must be reasonably accurate, and must extend over three generations of ancestors, or so much thereof as will leave no doubt whatever as to what the measurements for three generations will say.

"1. I have given detailed accounts of large numbers of cases in which improvement in mental and physical powers followed excess acquirements in previous generations. I will give $200 for any case in which improvement followed acquirements below the standard.

"2. I have given the details of many cases in which a decline in powers followed acquirements less than the standard. I will give a second $200 for any case in which a decline in powers failed to follow acquirements which were clearly and distinctly less than the standard.

"3. By taking large numbers of animals I have shown that the amount of improvement or decline in animal powers was, as nearly as could be determined by the measurements, exactly proportional to the amount of acquirement by ancestors above or below the normal or standard. I will give a third $200 if any group of animals is found for which this is not true.

"The aggregate of these offers is $1,000, and they extend to December 31, 1916. If the $1,000 is not captured it will not be because there is any lack of material from which the matter may be tested, or any difficulty in doing the necessary work. Published pedigrees and histories of men, horses, dogs and cattle furnish all of the evidence necessary for a complete investigation, and the mathematics involved is of the simplest kind.

"Men of great ability arise from common stock; many horses of the present day trot much faster than any horse was capable of trotting fifty years ago; cows frequently produce many more pounds of milk in seven days than was the utmost capability of any of their great-granddams, and dogs under tests in field trials show more 'class' than any of their ancestors. The claim is made that every case of this kind arose by the inheritance of excess development acquired before reproducing, and that it is impossible to increase the mental or physical powers of any kind of animal in any other way than by the inheritance of such acquirements. If any one can show the contrary he can capture my money.

DETAILS TO BE PUBLISHED

"The American Genetic Association, or its accredited representative, shall be judge in this matter, and if the money is captured the judge shall say to whom it shall be paid and how paid. It is expected, in case the money is captured, that the judge will publish his findings in the case, giving full details of the evidence upon which the decision is based.

"In this connection I will offer the following for consideration: According to the current theory of evolution, there was, some time in the past, a common ancestor for man and the higher apes. There have been less generations, and consequently there has been less selection, in the line leading from that common ancestor to man, than in the lines leading to the apes. Further back in the past there was a common ancestor for the higher apes and the lower monkeys. There were less generations, and consequently less selection in the lines

[3] Dynamic Evolution, a Study of the Causes of Evolution and Degeneracy. By Casper L. Redfield. Pp. 210. New York, G. P. Putnam's Sons, 1914.

leading from that common ancestor to the higher apes than in the lines leading to the lower monkeys. It would be interesting to have some one go through the different species of active animals in this way and then explain what selection had to do with the evolution of higher forms of animals from lower ones.

"Based on laws well known to science there is a hypothesis that the universe is a system running down. It would be interesting to have some one take these laws as a basis and then explain how there can be an evolution (increase) of animal powers by mutations.

"High speed at the trot is not a natural gait for horses. It is an artificial gait which never existed in any breed of horses until forced there by the art of man during the past century. At the beginning of that period running was the only high-speed gait, and horses would break into a run when forced for speed. Now we have natural trotters which will stick to the trot no matter how hard they are forced, and the trotting speed approaches the running speed. The most successful trotting lines are through those animals which were worked hard at the trot, were seldom bred, and had few generations to the century. Opportunity for selection was reduced to nearly its lowest limit in the most successful trotting lines. What theory other than the inheritance of acquired characters will account for this new thing found in the 'born trotter' of today?

"CASPER L. REDFIELD."

Any one who desires to investigate one of these points and wishes more information as to the method of procedure, may write to the editor of the JOURNAL OF HEREDITY, or directly to Mr. Redfield, whose office is in the Monadnock Block, Chicago, Ill. Dynamic Evolution may be considered as an authority on the meaning of any point in the offer. It contains a bibliography of previously published articles, to which reference may be made for details in case any point appears obscure.

Hardy Grains for the North

At the Rampart Experiment Station in Alaska, Agent C. C. Georgeson writes, "We have made many crosses of barleys in order to produce an early beardless variety which shall, at the same time, have a good head and a stiff straw, so it can stand the storms. To this end many and divers varieties have been crossed, and we have results which show a very large variation in the offspring. The plan has been to use the beardless—and, in some cases, both beardless and hulless—variety for the mother plant. This has been pollinated with early varieties of barley which have been mostly bearded, some of them six-rowed like the mother plant, and others two-rowed. We have not yet had time to establish a stable variety. Up to the present, the crosses have split up into a large number of widely divergent forms; thus, for instance, the one and two-rowed black, bearded barley, which was reasonably early, but whose chief merit was that it had a stiff straw and did not lodge badly, has been used for the male parent. The offspring has varied in a most astonishing manner. In most cases the beards have been eliminated, and instead of bristles 4 inches long, sharply barbed, many of the offspring have had abbreviated awns from one-half inch to an inch in length, and terminating in a hood. In color, they have varied from pure white to pure black, through many intermediate shades of yellow and purple. Some have been two-rowed, others six-rowed; some of them have been white or yellow two-rowed beardless, others have been six-rowed and bearded. The work is continued."

EXPERIMENTAL INBREEDING

Important Problem Tested With Various Animals and Plants—Rats Inbred by Dr. King for 22 Generations, Accompanied by Careful Selection and Followed by Excellent Results—The Lesson of Experimental Breeding for the Commercial Livestock Breeder.

PRACTICAL livestock breeders are, on the whole, firmly convinced that close inbreeding, that is, the mating of closely related individuals, is injurious, leading to degeneration and sterility. Their testimony was reviewed by Darwin[1] in a well-known chapter of his book on animals and plants under domestication; and he himself made the first important experimental contribution to the subject, by his plant pollinations, which led him to express the opinion that cross-fertilization is generally beneficial.

Ritzema-Bos (1894) was one of the first biologists to bring forward experimental evidence of value from animal breeding. During six years he continuously inbred a family of rats. In the first four years, covering 20 generations, no bad effects were observed, but in the following 10 generations the vigor and fertility of the race considerably declined. "The average-sized litter in the first half of the experiment was about 7.5, but in the last year of the experiment it had fallen to 3.2, and many pairs were found to be completely sterile. Diminution in size also attended the inbreeding, at the end amounting in the case of the males to between 8 and 20%."

At about the same time, Weismann carried on a similar experiment with mice, starting with nine individuals—six females and three males. "In the first ten generations the average number of young to a litter was 6.1; in the next ten generations it was 5.6; and in the last nine generations it had fallen to 4.2."

Such experiments gave support to the stock-breeder's belief that inbreeding is, in the long run, injurious—although it is hardly necessary to point out that no practical breeder ever inbred to anything like the same extreme degree as was done in these laboratory experiments. Of the various cases of extreme inbreeding of large animals may be mentioned that of Lord Derby, who mated brother and sister for nine generations of race horses, with distinctly bad results, and of J. Cossar Ewart, who inbred the descendants of a pair of goats as closely as possible for nine generations, until the strain practically "ran out."

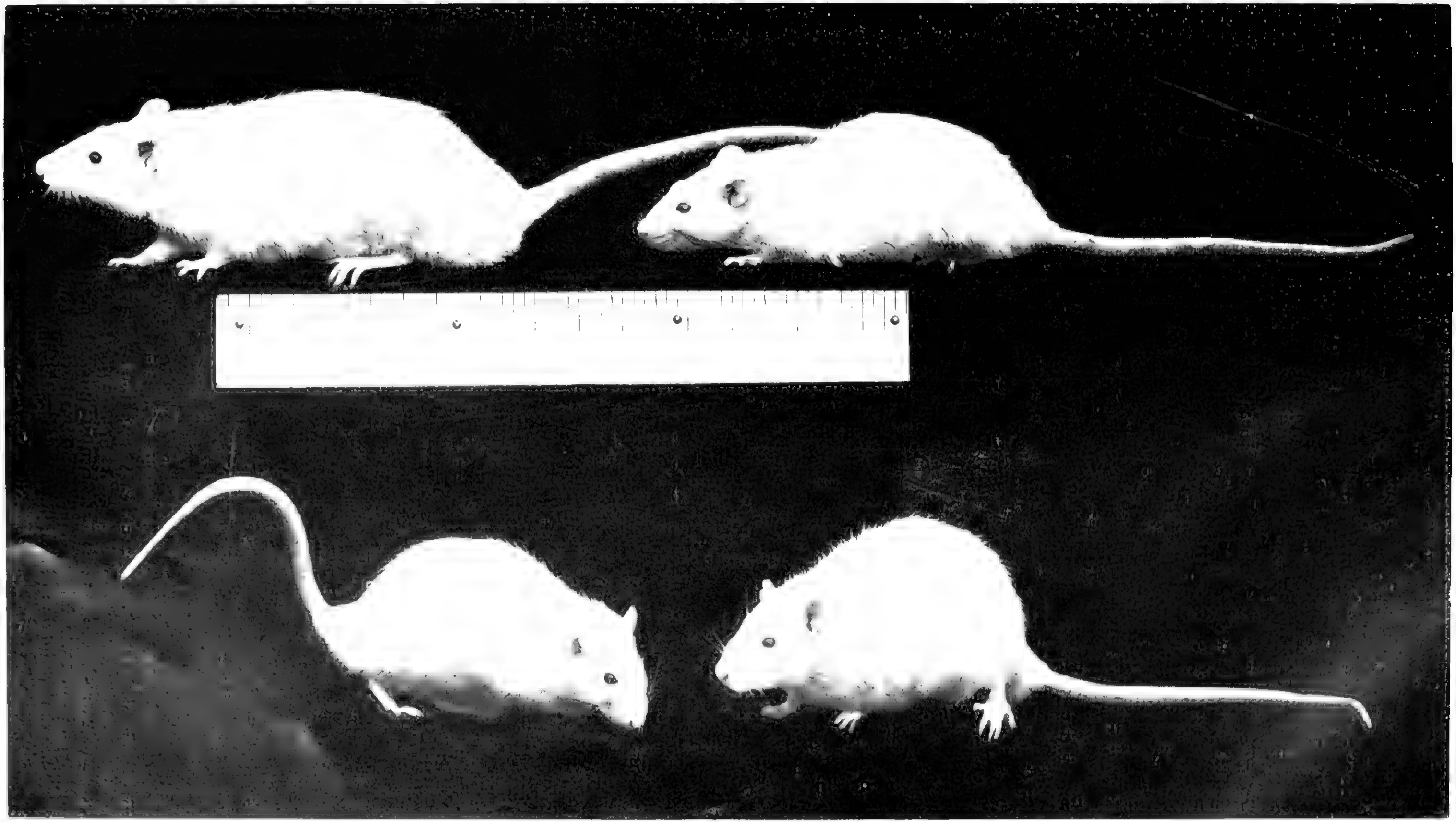
Experiments with smaller animals, on the other hand, have shown that under some conditions close inbreeding may be carried on for a long time without bad results. Thus, in the case of the little fruit-fly, Drosophila, Castle and his pupils bred brother with sister for fifty-nine generations "without obtaining a diminution in either the vigor or the fecundity of the race, which could with certainty be attributed to that cause. A slight diminution was observed in some cases, but this was wholly obviated when parents were chosen from the more vigorous broods in each generation."

WOODRUFF'S LONG STUDY

But the most extensive test of the kind is that of Woodruff, who carried the one-celled Paramecium, which usually reproduces by simple division, through more than 3,000 generations, without any marked deterioriation in the stock.

Such investigations, however, with fruit-flies, maize, and the like material,

[1] The evidence cited by Darwin was reviewed at some length by H. Kraemer in the JOURNAL OF HEREDITY for May, 1914, Vol. V, No. 5, p. 226.

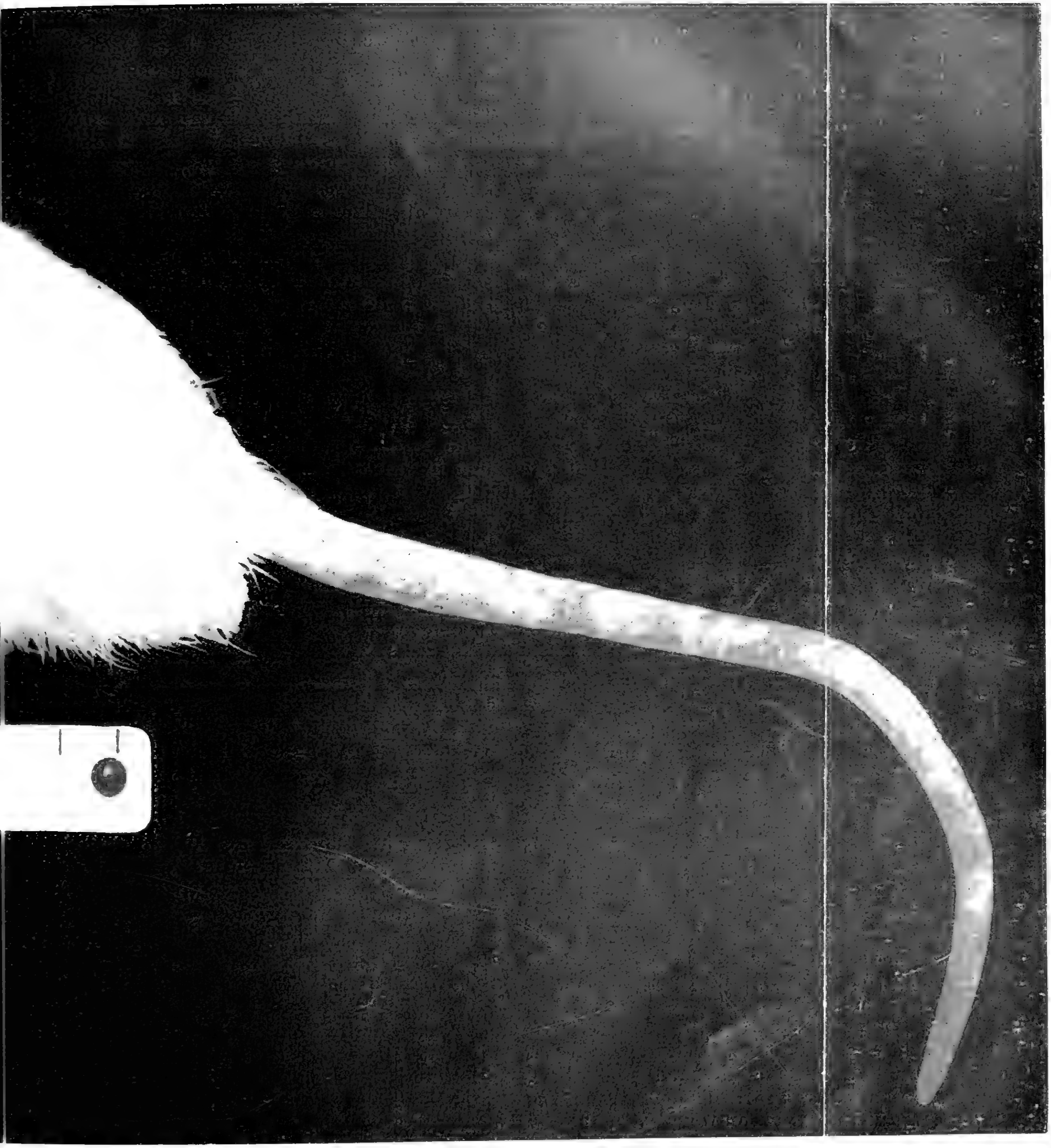


RATS INBRED FOR TWENTY-TWO GENERATIONS SURPASS THEIR ANCESTORS IN VIGOR

Breeders who are opposed on account of inbreeding or consanguineous mating may profitably consider the albino rats bred by Dr. Helen Dean King at the Wistar Institute, Philadelphia. At the bottom of the above photograph is a pair of rats taken from the ordinary stock of the Institute; they are not inbred. Some years ago Dr. King began to inbreed the descendants of two litters from this stock, and a pair of members of the seventeenth generation of inbred rats is shown in the upper part of the photograph. After twenty-two rat generations, they are larger, more fecund, and more vigorous than the stock rats from which they are descended. They grow more rapidly, and show no more defects or abnormalities than do the rats that are not inbred. The several strains of rats thus highly inbred show that inbreeding may be of great value to the breeder, if it is practiced on good animals, and only the best are selected from each generation for further mating. (Fig. 6.)

GOLIATH, THE LARGEST ALBINO RAT EVER RECORDED, IS THE

It has often been [illegible] erted by breeders that inbreeding leads to a reduction in size of the animals produced, that it prod
depended on [illegible] kind of animals used, and that if they had many good characters, these good characters are li
albino rat [illegible] by Dr. Helen Dean King, of the Wistar Institute, Philadelphia. He is now about one and one-half y
He is the [illegible] h generation of a stock which has been bred by the mating of brother and sister in each generation.
320 grams [illegible] at age. While the production of such an animal as this does not demonstrate that inbreeding is n
injurious, [illegible] at if carefully selected animals are mated in each generation, the effects of inbreeding may be h



OF SIX GENERATIONS OF THE CLOSEST POSSIBLE INBREEDING

and dwarfs. Geneticists have for some years contradicted this contention, maintaining that the results of inbreeding intensified in the inbred offspring. The truth of this position is strikingly illustrated by this life-size photograph of an is here shown slightly less than life-size; the actual measurement can be determined from the metric scale under him. months he weighed 550 grams, while the stock rats of the same age, bred without regard to consanguinity, average ts, it certainly proves beyond all contradiction that, in so far at least as rats are concerned, inbreeding is not necessarily cial. (Fig. 7.

are not easily accepted by the layman as furnishing conclusive evidence in the case of the higher animals. A number of breeding experiments with mammals are therefore being carried on in the United States at present, to throw more direct light on the problem of whether inbreeding is necessarily injurious.

The Bureau of Animal Husbandry of the United States Department of Agriculture has bred guinea-pigs for sixteen generations, on its farm at Beltsville, Md., mating brother and sister in each generation. No results of this work have yet been published.

Darwin pointed out that swine seemed to be particularly susceptible to the evil effects of inbreeding; the Delaware Agricultural Experiment Station is carrying on an experiment to test this point. Describing the work at the last meeting of the American Genetic Association, the director of the station, H. Hayward, declared that every line of descent had ended in disaster. Degeneration of the animals occurred, despite careful selection, in each generation, to get the strongest animals for further breeding.

It is now widely believed, by geneticists, that selection is the key to the results of inbreeding. Obviously, when two parents are mated, each carrying a given character (because of their similar heredity), their offspring will get this character with increased intensity. If the character is good, it is argued, inbreeding ought to be beneficial in respect to this particular character. If the character is bad, however, the offspring, getting a double dose of it, may naturally be expected to be inferior to its parents in regard to that character.

All that is necessary, then, we are told, is to select for further reproduction the best animals in each generation. By so doing the evil effects generally attributed to inbreeding can be at least postponed indefinitely.

Such a statement conforms to a widely-accepted theoretical view of inbreeding. It has not seemed to produce good results in the Delaware station's pig breeding; but in another careful test it has vindicated itself completely.

This test is the experimental breeding of albino rats by Dr. Helen Dean King at the Wistar Institute, Philadelphia, Pa. It was first started to determine whether inbreeding alters the sex-ratio by increasing the relative number of males, as a number of investigators have maintained. Negative results being reached on that point, it was continued to test whether strains of rats with disproportionate sex-ratios could be produced by selection. The success on these lines was described in the January issue of the Journal of Heredity (Vol. VII, pp. 9-11).

It is from the point of view of simple inbreeding, however, that the experiment is of interest here. Its scope will be understood from the fact that it is now in the twenty-second rat generation, that a thousand rats are being produced in each generation at the present time, and that about 10,000 inbred rats have, up to date, been produced, and a large number of them carefully weighed and described at regular intervals.

The experiment was begun six years ago with a stock litter of four albino rats, two male and two female. From these two pairs have come all the rats since produced, and each line of descent has been kept separate, so that there are two series, A and B. In each of these series the closest inbreeding has been practiced in an unvaried way, brother and sister being in every case mated. About twenty selected females in each series are reserved, in each generation, to continue the experiment, and each of these is mated twice to a brother from the same litter.

Although these females are carefully selected from the large number available, it must be noted that the basis of selection is primarily a disproportionate sex-ratio, and the general good qualities of the animal are taken into consideration only secondarily. But as far as is possible without conflicting with the primary interest of the experiment—namely, the question of sex determination—the best rats are selected in each generation, size, vigor, fecundity and similar characters being taken into account. In other words, Dr. King is

trying to avoid evil effects from inbreeding in exactly the way that geneticists have told the practical breeder to go; she is picking out only the best breeders in each generation, and discarding all the unfit.[2]

RESULTS ARE GOOD

The result seems to have demonstrated that the geneticists were right when they advised such a course—at least, as far as rats are concerned. For these laboratory rats, which have been inbred as closely as possible for twenty-two generations, are in every respect superior to the stock rats from which they took their start six years ago, and which have since then been bred in the usual indiscriminate manner.

Beginning with the seventh generation of the experiment, from three to five litters in each generation of each series have been weighed, first at 13 days of age, then at intervals of one month until they were 15 months old. Their growth has been carefully compared with that of the stock rats, bred under the same environmental conditions.

Growth in body weight is practically the same in inbred and in stock albino rats during the first sixty days of postnatal life, both in the males and in the females. After this time, however, inbred rats exceed the stock rats in body weight at any given age. After 150 days of age, inbred males are about 15% heavier than stock males. In the case of the females, which are always smaller than males, there is much less difference between the growth of the stock and inbred rats; nevertheless inbred females are, throughout adult life, about 3% heavier than stock females.

When it is remembered that selection for size has been only secondary, selection for sex-ratio being the first consideration, this increase in body weight appears to be a very striking accompaniment of the inbreeding which has been done.

What of the sterility which is said, sometimes, to be an inevitable result of inbreeding? The rats certainly do not show any falling off in that respect. "We have found that the average litter of stock albino rats contains seven young," Dr. King says.[3] "Records for over 1,200 litters of inbred rats show that the average number of young per litter is 7.4. Litter size in the rat, therefore, is seemingly increased and not diminished by inbreeding, even when, as in these experiments, there has been no direct attempt to increase the fertility.

"Under the conditions in our colony inbred rats live fully as long as do stock rats and they appear equally resistant to disease; so their constitutional vigor does not seem to be impaired as yet."

The reader will perhaps wonder whether there are not a great many "wasters" produced in each generation—animals defective in vigor or in some other respect. It can be said that the proportion of defectives appears to be no larger in the inbred series than in the stock rats. Furthermore, no female selected for breeding has ever proved sterile.

Dr. King sums up the experiment to date as follows:

DR. KING'S CONCLUSION

"The results so far obtained with these rats indicate that close inbreeding does not necessarily lead to a loss of size or of constitutional vigor or of fertility, if the animals so mated come from sound stock in the beginning and sufficient care is taken to breed only from the best individuals."

In the face of the data she presents, one can hardly refuse to accept this conclusion.

It must be noted, however, that the experiment can not, in the nature of things, settle the problem of whether inbreeding is, *of itself*, injurious. The experiment proves conclusively that if

[2] The only abnormalities so far noted in the inbred strain, since external conditions were uniform, are: one tailless rat, killed by mother soon after birth; half a dozen cases of absence of one or both eyeballs. This latter defect is equally common in the rats that are not inbred.

[3] In an address before the Pediatric Societies at Philadelphia on November 9, 1915. From this address (which has not been published) most of the facts herewith presented are derived.

any injuries result they are not so great but that they can be counteracted by careful selection of the animals used.

And after all, does the practical livestock breeder need to know any more than that? For the sake of clearing up theoretical views on the subject, it would be highly desirable to get evidence that inbreeding is or is not injurious in itself, wholly without regard to selection; but such can hardly be had from experiment. And as every breeder, under ordinary circumstances, is selecting from his stock all the time, it is sufficient for him, if he is told that by careful enough selection all evil effects have been avoided, and good results gained in an experiment with rats, in which they were closely inbred for a much longer time than would ever be used in the commercial production of livestock.

But no one experiment will settle the general problem of inbreeding. What takes place in rats might or might not be expected to take place in swine; at any rate the Delaware station could not make it take place. And no breeder could be advised to inbreed cattle for twenty-one generations, even with the most rigid selection, and not expect trouble, merely because rats have been successfully inbred for that length of time.

Great progress has been made during the last generation in solving the problem of inbreeding, but the final solution has by no means been reached. It can hardly be reached until we know exactly what inbreeding means physiologically; and in this field we are at present largely dependent on hypothesis.

The results of Dr. King's experiment in breeding rats, and the whole teaching of genetics, however, can be safely followed by the practical breeder to this extent: that he can use a moderate degree of inbreeding through a number of generations without fear of evil results, *provided he is mating the best with the best* in each generation; and that the results in most cases will be a considerable improvement in his stock.[4] The superstitious fear of inbreeding in any form, which long hung over practical breeders, is rapidly disappearing; for the geneticist it long ago ceased to exist.

[4] Much of the improvement in German livestock during the last generation is due to the moderate practice of inbreeding on the advice of geneticists, according to Dr. Georg Wilsdorf. See his discussion of the subject in "German Zootechny," JOURNAL OF HEREDITY, March, 1915, Vol. VI, No. 3, p. 109.

Annual Business Meeting of the Association

At the annual business meeting of the American Genetic Association, held in Washington on January 13, it was decided to hold the next general meeting in connection with the American Association for the Advancement of Science in New York, December 26 to December 31, 1916. O. F. Cook, David Fairchild and Arthur W. Gilbert, whose incomplete term of two years as members of the council expired, were elected to succeed themselves. The secretary's report showed the membership of the Association to be 2,722.

Annual Meeting of the Council

The annual meeting of the council of the American Genetic Association was held in Washington on January 18. The present officers were re-elected. Mr. Kearney was elected a member of the executive committee, to act with the president and secretary. Plans were considered for securing advertising for the JOURNAL.

WHAT TO SAY ABOUT MARRIAGE?

Many of Those Who Seek Help from Eugenics Do Not Receive Satisfying Replies —Others Handicapped by Lack of Sufficient Acquaintance Among Marriageable Persons—Scope of the Science is Not Adequate Unless It Meets These Two Problems.

A. E. Hamilton, *New York, N. Y.*

A POPULAR article in one of our very popular magazines, entitled "Do You Choose Your Children," brought to the Eugenics Record Office hundreds of inquiries concerning heredity in relation to marriage and parenthood. These ranged up and down the emotional scale from cold questions concerning genealogical data to the most intimately confidential outpourings of mind and heart on subjects of vitally personal concern. A casual leafing through of this batch of letters gives an adequate sampling of their trend. The following fragments are typical.

"This article brought home to me things I had never thought of before" . . . "Too late to profit by this article myself but I have two sons who" . . . "Will you trail my ancestors as far back as possible?" . . "I am deeply attached to a certain young lady and on her family history our future relations will probably rest" . . . "My family is seemingly all right, but I am paralyzed in my left leg" . . . "I am now in college and in splendid health, but when a child I had an epileptic fit. What would happen if I married a girl without this trait." . . . "Now that I am engaged the subject of heredity looms important" . . . "If I had read that article a year ago, I would not have married until I had investigated my ancestry" . . . "There are weak eyes on both sides, tendency to catarrh and deafness" . . . "I am intensely interested in the highest development of the race" . . . "Is cancer inherited. Glaucoma. Astigmatism." . . . "My baby was born before time, and lived only a couple of hours, can you tell me why?"

So they run, page after page going into minute description of family diseases, abnormalities, slight deviations from the supposedly normal, apparent tendencies to this or that condition of mind or body. These people want to know about maternal impressions, about the prenatal care of children, about the possibility of overcoming inherited tendencies by proper compensatory training in early years. They bitterly regret the lack of knowledge that was theirs, and equally rejoice in their belief that now this knowledge, backed by all the weight of scientific authority, can be had for their children.

AN UNSATISFYING ANSWER

The Eugenics Record Office answers most of these letters of inquiry with the suggestion that if the accompanying record of family traits is properly filled out, perhaps something may be said in regard to the specific situation.

A small percentage of those who receive these record blanks fill them out and send them back. A small percentage of those that come back are carefully wrought and show that their makers have caught both the spirit and the letter of scientific inquiry into family traits. But the number of people who have the interest, intelligence, patience, perseverance and time thoroughly to fill out one of these rather complicated record blanks is negligible in so far as it concerns the problem of what the science of Eugenics is called upon to say to those who, for themselves or their children, are thinking in terms of marriage.

Eugenics has pointed to the defective fruit on our family trees. It has chilled the hearts of many into furtive inquiry

concerning their future and their children's future. If Eugenics as a science does not answer, nescience will—and it does.

The hands of palmists, seers, chirographers, astrologers, phrenologists and mediums are crossed with silver mounting into hundreds of thousands of dollars a year, for the information they give on the subject of courtship, marriage and probabilities concerning children. The word Eugenics appears already in the literature of the underworld of quacks and fakirs, and on the gilded signs of medical museums and mail-order "Universities." This, of course, is to be expected, for they seize on every instrument of popular fancy to further their trade; but do not the scope of the questions that are asked, and the range of the answers given and paid for in cold cash, suggest that there is a wider field for the scientific Eugenist, even at this stage of the game?

The Eugenics Record Office, through the interest of Mrs. Wortham James, was able to try a piece of extension work in the form of lectures on the general subject of Eugenics. These lectures attracted favorable attention, and were well received largely because to those who heard them the word Eugenics connoted heredity in relation to the problems of marriage and parenthood. Audiences were made up of people whose matrix of ideas was ready to receive new conceptions of science up to a certain limit, and in so far as these lectures carried material that squared in with that limit they were useful; but they usually overshot their mark because the lecturer wrongly assumed that the latest developments in scientific research would find a cordial welcome. But marriage and parenthood to the average college student mean far more than the facts concerning the segregation of unit characters in plants and the inheritance of eye color in man.

THE APPROACH TO EUGENICS

Eugenics as an idea and an ideal of better marriages, better parenthood, better babies and a better race is a drawing card of no small power, but to get Eugenics into the tissue of society as part of its thinking and feeling, science must take advantage of those keen personal interests that, while not strictly biological, are yet very close to the major problems of biology. This, again, can be illustrated with the kind of questions young men and women are asking, questions which indicate the mental content and emotional tendency that Eugenics must recognize and use if it is to make headway.

"I have just got under way with a piece of work that is taxing me heavily, the more so because I thoroughly enjoy it and am making it successful. Next spring I want to be married, and I want to be a mother as soon as I can. I have an offer from a relative to take charge of her two children for the rest of this year, and just devote myself to their care, which means outdoors, happy times, very little strain, healthful hours and many points of advantage for one who wants to be in good shape for motherhood. Now, from the standpoint of Eugenics and heredity, is it worth while for me to sacrifice my work and take up this other line for the good of my children, or will their inheritance be just the same if their stock is sound?"

Had this young woman already filled out a record of family traits, her question would remain the same concerning the welfare of her children-to-be. She wanted a specific answer to a specific question, from someone who had authority that she could respect back of the answer, and she put her question to me because I had the reputation of being an authority on Eugenics. Now I know perfectly well that we have no proof that running a successful class in handcraft work is damaging to the germ plasm, and therefore injurious to our racial stock; but I unhesitatingly told that young woman that if she considered motherhood her capital profession in life, she would be doing the eugenic thing by dropping her job, if she could afford it, and taking her relative's children in hand. I said "if you can afford it" because it might have been that her job was paying her well enough to enable her to marry in the spring, and that per-

haps the other work would not, which would make a difference.

PRESENT SCOPE TOO NARROW

Such questions as this are more and more frequent. They come to physicians, of course, but in the present chaos of contradictions concerning nature and nurture, even our physicians are casting about for some authoritative anchorage for their ideas on heredity in relation to Eugenics. And what are we who represent the cause of Eugenics nearest its fountain head doing to meet this situation? Thus far our tendency has seemed to be to try to draw fine lines of distinction between euthenics and eugenics, and when hard thinking about such things as the physical and spiritual preparation for motherhood, or the technique of the affections are concerned, to retire into the confines of our laboratory experience.

Eugenics needs, primarily, the moral support of as many people as possible for its activities in sound research. But in order to keep the attention, interest and sympathy of its friends it must continue to have something to give, and it must continue to widen its scope as new situations arise within its field. Not that it must shift its base one iota, but only that it keep its fundamental purpose constantly in sight by showing its relations to problems of vital human interest wherever these may touch its fringe.

What shall it say, for instance, of marriage bureaus?

More people read *Physical Culture* and other magazines that try to deal fairly with the problem of mate-getting in most "unscientific" ways than will be reading THE JOURNAL OF HEREDITY for many years. Bernarr MacFadden once tried out a page or two where advertisements could appear of young men and young women who wanted to marry each other on a basis of mutual interest in physical culture and outdoor life. But *Physical Culture* has been getting more and more "respectable" of late, and I have missed those interesting human items that now seem to be left entirely to the matrimonial brokers and their cheap weeklies and monthlies.

But even in these journals that never breathe the air of our railway and subway news stands, there are advertisements that ring a wholesome note.

> "I am a young man of 35, German descent, Protestant, refined, college graduate, best of health, very fond of music, play the violin, blonde, blue eyes, brown hair, height 5 feet 7½, weight 145, and am very young looking. Have no bad habits. Occupation, electrical engineer, in good standing. Wish to marry a sincere lady of education, refinement, and one who is broad minded in religious views, having some means, and who wants for a husband a healthy, active man, a lover of nature, literature and all things that tend to elevate one to a higher artistic, spiritual and intellectual life. For particulars address'—etc.

There are eighty-four advertisements from young men on the page from which I have lifted this sample. It may be that this sort of thing is not in good taste, that many advertisements are run for purely commercial reasons, to catch small capital through marriage as a bait, and that these matrimonial journals lend themselves to much quackery. But the fact remains that they are sometimes the only available means for young men and women who want to marry outside their narrow circle of acquaintance, to get in direct touch with other young men and women of like tastes and inclinations. And the cheerful frankness and straightforwardness of these announcements is positively charming in our world where such things are under respectable tabu.

The influence of the astrologer is apparent in many of these attempts to break through the loneliness of life, as though good marriage were contingent on the zodiac.

> "Welsh-Scotch, brown eyes and hair, ruddy complexion, in perfect health, born under canser sign, character will stand the most rigid examination, lover of home and children, interested in eugenics and physical culture, outdoor life and new thought. Do not use tobacco or liquors. . . . I want a good, loving wife between the ages of 26 and 29, a home-keeper and a Christian, prefer an Eastern Star or a Rebecca, with blue eyes, blond hair, height 5 feet 8, weight 140 to 160. Only those who are really interested need apply as I am very busy and do not care for foolish correspondence."

I have been surprised and sometimes not a little shocked at the questions that have been put to me after lectures, in private, by people of recognized standing as to ability and intelligence in their communities. The influence of the cheap and bogus literature on marriage, parenthood, prenatal influences, crops out everywhere when the lid of tabu is lifted and people discuss what they know or think they know or want to know, with one supposedly familiar with the facts. When I find, after lecturing for forty minutes to a group of three hundred physicians, that I am cornered for private discussion of the science of phrenology in relation to heredity and mate selection, that doctor and layman alike have fond beliefs in maternal impressions and weird psychic influences affecting the unborn, I can read such advertisements as that of our friend who is interested in Eugenics and the sign of "canser" with charity. Says another:

> "Correspondence preferred with those having birth dates from April 19 to May 20, January 20 to February 19 or from August 22 to September 23."

Religion seems to be stressed almost equally with social position, economic outlook and positive qualities of health and character. Some of the frank limitations as to correspondence are a bit amusing at times:

> "Widows with children, Catholics and flirts need not write."

> "Catholics, divorcees and insincere persons kindly do not write."

There does not seem to be such tacit acrimony on the part of Catholics toward Protestants. However, the religious complex, as our modern psychologists label it, is undoubtedly a strong and important factor in marriage selection and one with which any broad science of Eugenics will have to deal.

One of the finest young doctors in my acquaintance, a man of exceptional personality and intelligence, asked me what in the world he could do about being in love with a Catholic girl, whose religion his intellect refused to accept, and yet who made religious harmony a cardinal point in their relations. He did not advertise for a wife, but from the distraught state of his mind concerning his engagement and marriage, and the effect of possible disharmonies upon family and children, I should almost judge that he would have done more wisely had he consciously and directly put himself in touch with a girl whose brain functioned more like his own.

In comparison with the daily topics of our respectable press, and the bulk of our journalistic fodder, these cheaply printed and homely worded matrimonial sheets are a veritable step into higher and happier levels of reading and thinking. Somehow the will to believe that most of these expressions of aspiration for the solid goods of life are real and genuine gives one a renewal of confidence in the heart of the common people who write them out and have them printed at the rate of a cent a word.

> "Is there some good Christian lady between 25 and 40, of good character, good cook and housekeeper, fond of children and ranch life, who wants a good home? . . . " etc.

> "I am a young man of 26, college graduate, come from a well educated, aristocratic family, occupation druggist and chemist, have the best of health, fond of books, opera, athletics, 6 feet tall, weight 170 pounds . . . " etc.

> "Unable to accomplish a burning heart's desire unaided, advertiser takes this unconventional method to obtain the longed-for wish. Active German-American, age 50, a Christian, perfect health, absolute teetotaller, never married, have varied business experience. Wish to hear from a marriageable maiden or unencumbered widow who has a hankering for free, outdoor life . . . " etc.

Health, love of children, desire for a home, sound financial standing or ability to support a wife and maintain a home, and good character are the principal points emphasized throughout. Personal idiosyncracies are dwelt upon sometimes at length, and seem quite amusing to us who merely read the printed word; but from what little I know of the class of people who write these ads., mechanics, farmers, railroaders, mill foremen—mostly from our solid labor stuff—they are usually frank expressions of a deep and earnest desire.

One of the cardinal points in Galton's eugenic program was the study of in-

fluences affecting marriage. One of these influences is undoubtedly the willingness of a growing number of us to approach marriage frankly and open-eyed as to the desirable elements that go to make it a success. Another influence, that results in a demand for such vehicles as our marriage papers, is the narrow range of acquaintance between our young men and young women. This is especially the case in our rural districts, from which most of these pathetic advertisements come. But it is true wherever I have travelled, and while such a subject does not lend itself easily to scientific treatment, a discussion of some of the related facts that are constantly coming to hand, and wherein we may read the signs of the times may prove profitable. In a subsequent article I am to be allowed the privilege of presenting these.

Plant Breeding in Kansas

Three distinct lines of plant breeding are under way at the Kansas State Experiment Station: (1) the breeding of cereals for disease resistance; (2) the breeding of alfalfa for drouth resistance; (3) the breeding of maize for the same quality. Numerous hybrids have been made between four rust-resistant wheat species—an emmer, two durum wheats and an einkorn—on the one hand, and various pure lines of winter wheat originated at the station, on the other. A considerable number of hybrids have been produced recently between Khapli, one of the best resistant spring grains, and a number of pure lines of winter wheat. In the endeavor to breed smut-resistant sorghums, many crosses have been made between milo, which is entirely resistant to both the grain and the head smuts, and two kafirs and feterita.

The alfalfa project is being carried forward by hybridization between various strains and species of *Medicago sativa, falcata* and *ruthenica*; the drouth-enduring species *M. arborea*, a perennial plant from the drier parts of the Mediterranean; and some drouth-resistant root-propagating alfalfa plants obtained from the Colorado Experiment Station; and, as the other parent, some of the best pure lines of commercial alfalfa, picked out by the department of botany at the Kansas station.

The maize-breeding project is further advanced, in that three families out of forty-four originating from hybrids of 1910 showed evidence of extreme resistance to drouth in the F_2 generation during the very severe summer of 1913. Of these three families, the most conspicuously successful originated from a cross of the drouth-resistant Mexican variety known as Esperanza with the F_1 generation of a cross between a western Kansas white dent corn known as Sherrod's and a strain imported from China. Under the high temperatures of the summer of 1913 the leaves of the creation described did not burn, fire or cook, but only rolled slightly, while fields of ordinary corn were practically destroyed. The strain has an unusually strong development of leafage and bears a fair-sized ear of the white dent type; the station thinks it will be a marked success when tried on a commercial scale.

"Journal of Heredity" Used as College Textbook

The current issues of the Journal of Heredity have been designated as one of the required textbooks in the class in Heredity and Genetics, by Professor William H. Gates, of the Louisiana State University, and special arrangements have been made to supply the Journal to the twelve students in the class during the present semester.

BUD VARIATION

Washington Navel Orange "Running Out" as a Variety—Reason Found to be Due to Wrong Methods of Propagation—Can be Conserved by Utilization of Good Bud Variations and Avoidance of Bad Ones—Methods of Practice.[1]

A. D. Shamel

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OF THE many factors influencing the production of a fruit tree, there is one which until lately has been often overlooked, and which we wish to consider briefly as it affects the navel orange industry of California.

This factor is the variation in types of trees and fruits resulting from the propagation of sports or mutations.

While we do not wish to underestimate the importance of other factors, we do feel that the relation of variable-type trees and fruits in our groves to profitable orange growing has been largely overlooked by everyone concerned. We hope to be able in this discussion to call attention to the importance and significance of the condition of bud variability existing in our orange trees, from the viewpoint of six years of continuous investigation of this matter, and to offer some suggestions in this connection for the improvement in production, both as regards quantity and quality of the Washington Navel orange variety.

It will not be possible here to go into any of the details of our experiments and observations. In a general way these investigations have been carried on by means of continuous individual tree study. In our experimental plots we have usually selected 100 trees for a performance record plot. Frequently we have several plots in one orchard, so as to take into account all possible differences in soil conditions in a given orchard.

In addition to these select plots, where detailed individual tree and fruit studies are made, we have been able to study individual tree performance record data secured by several orange growers. These data are usually made up of the amount of fruit produced by each one of the trees in the orchard, together with some notes as to the commercial quality of the product of each tree.

VARIETY BADLY MIXED

The results of our investigations have shown clearly that in the Washington Navel orange variety we have a number of diverse types, many of which are undesirable and worthless. It is our observation that the younger groves, that is, those farthest removed in time from the parent trees, show a larger proportion of these inferior types than the older orchards, or those not so far removed from the two parent trees. In other words, our experience shows that owing to the lack of careful bud selection and to poor propagation methods, the proportion of poor type trees is constantly increasing in the younger bud generations. This process of varietal deterioration in varieties propagated from seed is frequently called the "running out" of the variety. As a result of many observations in different navel orange orchards, varying in age from the first planted grove in California to those just coming into bearing, we are reluctantly forced to the conclusion that the Washington Navel orange variety is "running out."

[1] Part of an address before the California State Fruit Growers' Convention, Visalia, Cal., November 19, 1915.

The reason for this condition is easily found upon investigation. Of the eleven common types of the navel orange in California, the most undesirable ones from the standpoint of fruit production are those showing the greatest vigor of growth. The trees of these types throw unusually large numbers of suckers, which have been, until recently, highly prized for budwood. Naturally, under the existing methods of propagation, a large proportion of budwood is cut from these vigorous vegetative trees and a comparatively small proportion of budwood from the trees of the productive and desirable types.

Another way of explaining the running out of fruit varieties by reason of the lack of intelligent bud selection in propagation, as in the case of the Washington Navel orange, is the difficulty of propagators in securing budwood from the best and most productive trees. There is no question but that it is difficult to secure large supplies of non-bearing budwood from the best trees, particularly the sucker growth, because such trees usually produce but little sucker wood. On the other hand, by the use of fruit-bearing budwood instead of sucker wood for propagation, there is no difficulty in securing adequate supplies of budwood from the best trees. In fact, if fruit wood is used for propagation instead of sucker wood, one can secure more budwood from good trees than from poor ones.

MANY DRONE TREES

In our performance record plots, located in some of the best navel orange groves in Southern California, we have found that about 25% of the trees are drones, that is, are unproductive and undesirable from all commercial standpoints. Our records show that if these trees had been replaced by the average of the remaining 75% from 1910 to 1914, inclusive, these orchards would have produced about $100 per acre more than was actually the case. These figures are from the actual figures of production and from the prices actually realized for the fruit from these orchards in eastern markets. One of our cooperators, who has kept an individual tree record for the past four years on a large acreage of navel oranges, tells us that his figures show a loss of about $100 per acre each year as a result of the presence in his orchard of drone trees. In view of the close agreement of our experimental and cooperative commercial records, I think we can safely conclude that in our best orchards the loss from trees of poor types has been about $100 per acre annually. Of course, in poorer orchards, especially those having a notorious mixture of types of trees, the loss has probably been much greater. How much disappointment, loss of opportunity, and heartache have been the result of the past system of propagation of our navel orange and other fruits no one can estimate. We have made tree census records in certain navel orange groves which show more than 70% of inferior type trees. These orchards have blasted the hopes and opportunities for success of many men and are blights upon the fair reputation of our citrus industry.

This state of affairs need no longer exist, for we now know that many, if not all, of these inferior trees in existing orchards can be replaced with superior ones, and that the most productive and valuable type of Washington Navel orange can be isolated by bud selection based on performance records, so that this variety, perhaps the most important and valuable in all horticulture, can be conserved and improved, instead of being allowed to continue its deterioration until it altogether "runs out."

ACCURATE RECORDS NEEDED

The first essential to progress is individual tree records to give definite and reliable information as to the performance and behavior of fruiting trees. Individual tree performance records can be compared with the Babcock test for dairy cows, trap nests for laying fowls, centgener tests of strains of corn or other grains, and other methods for securing useful and valuable knowledge of individual animal or plant behavior. The importance and value of individual tree records can only be fully appreciated upon actual use

and trial. So far, in our experience, we have failed to find a user of individual tree records who is not fully satisfied as to the value of this work.

If the amount and quality of fruit produced by each tree in the orchard during a period of several years is known, we are at once able to locate the "drone," "robber," or off-type trees and limbs, so that these trees may be replaced with the best type, usually by top-working entire trees with carefully selected buds, or the removal of the undesirable limb sports by pruning. In other words, the individual tree records furnish a reliable basis for the removal of the drone trees and limbs, and the development of uniform orchards. The advantage of uniform orchards can well be appreciated by those who have to do with the picking, assorting and handling of crops of fruit, as well as from the standpoint of the improvement of the quality and quantity of the yield of orange groves as a whole.

Another most important advantage of the collection of individual tree records is the location by this means of desirable trees as sources of budwood for propagation. No intelligent or unprejudiced person studying our best orange groves in the light of several years' individual tree records, will ever be satisfied with buds secured in the ordinary manner. As one prominent nurseryman recently expressed it: "The day of the ordinary nursery tree is about over in California." We are very glad to say that many California and other nurserymen are adopting the use of individual tree records as a basis for the selection of parent trees for propagation. Several of the leading and most successful citrus growers in California have repeatedly told us that they would not take an ordinary nursery tree as a gift, under any possible circumstances.

We have carefully worked out what we believe to be the most practicable method of keeping individual tree records. It includes the numbering of every tree in the orchard, and the record of its yield by a man detailed for that purpose at the picking season. It is not necessary here to give the details of this method, but we wish to emphasize the fact that some such method is an absolute prerequisite of successful bud selection.

BUD SELECTION

Our interpretation of the term bud selection is the selection of buds from individual trees and limbs of known behavior and, of course, commercially speaking, from those trees and limbs producing the most regular, largest, and best crops of fruit. We have failed to find, in our six years of contact with orange growers, one of experience who has any doubt as to the importance and value of bud selection. We may also add that we have also failed to find during this time a deciduous-fruit grower, or any experienced propagator of vegetatively propagated plants, who has any doubts as to the value of intelligent bud selection. The only criticism we have heard in this connection is that concerning propagators who claim to use care in bud selection, but who are known to use only the ordinary methods of securing budwood with little or no attention to or knowledge of the trees or limbs from which the buds are cut.

We have actual knowledge and definite information of the origin of some of our most valuable horticultural and other varieties from bud mutations, and the propagation of many uniform and more than ordinarily productive and profitable orchards of trees or plantings of vegetatively propagated plants, as a result of systematic bud selection by the propagators. We have been so insistently taught that the only improvement of fruits possible is the origination of new varieties by hybridization, that some of us have overlooked the more important and practical field of the conservation and improvement of our valuable established varieties by bud selection. The same condition existed not many years ago with respect to the improvement of corn, tobacco, cotton, and other farm crops by seed selection. It is not likely that any sane person today would take the stand that it is impossible to improve our established varieties of farm crops by seed selection. However, a

few years ago many people had grave doubts that anything of value could ever be accomplished by seed selection. We are now ready to assert that equally good results can be achieved by bud selection as has been accomplished by seed selection, in which we had the good fortune to be of some service in the case of the improvement of certain varieties of corn, tobacco, and other crops propagated from seed.

SELECTION FOR PERFORMANCE

The best method of bud selection, we believe to be that of securing buds only from those trees having satisfactory performance records. The performance records of trees selected as parent trees should include not only a complete record of several successive seasons' production, but also all available or possible information as to the presence of sports, or off-type fruits, in the crops; and all other information of value in considering the relative value of a tree as a source of budwood for propagation. We hope eventually to include progeny tests of select parent trees for consideration in the selection of the best budwood. When this point is reached, we will have established sources of genuinely pedigreed buds. In order to lay the foundation for pedigreed buds, performance records of parent trees are essential. With this information, together with performance records of the progenies of the parent trees for one or more bud generations, pedigreed trees will become an accomplished fact.

After the parent trees have been selected, the next step is the selection of the budwood for propagation. As a result of our experience in this connection, we have adopted the practice of cutting for budwood only that growth bearing typical fruits. This has been called a radical step. It has many advantages to recommend it. The only objection that has been offered against this method in practice, so far as we know, is that such budwood is small and the buds may not live as well as the "fat" sucker buds. We have assisted in the propagation of hundreds of thousands of fruit-wood buds during recent years. One illustration of the successful growth of these buds will show how they have behaved on the whole in our experience. A cooperator budded a nursery of more than thirteen thousand orange seedlings in 1914, using only fruit-wood buds cut from Valencia and Washington Navel orange budsticks, none of which was of greater diameter than that of an ordinary slate pencil. This budwood was in every case bearing typical fruits and was of the period of growth preceding the bloom producing these fruits. The budsticks contained, on the average, five buds each Out of over thirteen thousand seedlings so budded, only two buds failed to grow. We could offer many other similar experiences if necessary, and have only one report of any difficulty with the use of such buds in either seedling stocks or topworked bearing trees.

BUDWOOD CAREFULLY PICKED

A little reflection will reveal some of the reasons for using this character of budwood. The most important one is that it enables the bud cutter to avoid taking budwood from off-type limbs or sporting branches. This is particularly important where few or no performance record data are available. This method naturally tends to the cutting of most budwood from the best bearing type of trees. The old sucker budwood method led, naturally, to the cutting of the most budwood from the poorest bearing type of trees. While we have no absolute proof, we feel inclined to believe, from our observations to date, that fruit-bearing budwood produces earlier bearing trees than those propagated from sucker wood. It is absolutely certain in our experience that the buds from fruit wood secured from heavy bearing type trees produce trees of considerably earlier bearing habits than those propagated from sucker wood cut from trees having a tendency for the production of large numbers of suckers.

After the typical fruits, by which we mean the best, and only the best, from the select standard type trees, have been severed from the budsticks, they can be included in the regular pick, providing care has been used in cutting them so that they will not have been

VARIATION IN ORANGES FROM A SINGLE TREE

This Washington navel orange tree was grown from a single bud. Conditions, were, therefore, as favorable as possible for the production of uniform fruit. Yet it is obvious that the fruit is far from uniform, some being good and some nearly worthless. The existence of such a condition in orange groves has been the cause of great financial loss in the past, but by the practice of bud selection, this loss is being gradually eliminated. (Fig. 8.)

mechanically injured. In practice we rarely attempt to save the fruits cut off with the budwood, on account of the extra time needed to care for them properly and insure their freedom from injuries.

Our practice is to use this budwood as soon as cut from the tree, or as soon as practicable. If it is desirable to hold it for some time, the budwood should be packed in moist, not wet, sphagnum moss, and stored in a cool place. If the budwood is likely to be kept for a long period, we would advise first moistening the moss in which the budwood is to be stored, then sterilizing it with live steam for an hour or more, afterwards drying the moss by running it through an ordinary clothes wringer.

We cut all budwood possible from a select tree, tie it in a bundle, and place a tag with the bundle, bearing the parent tree number. The buds from a parent tree are all inserted in order and the budded trees numbered, so that the buds can be traced back at any time to the parent tree. Whenever practicable, we would like to see this plan carried out so that additional knowledge of the results of bud selection may become available for the benefit of the citrus industry as a whole.

BUD IN THE SPRING

The best time for cutting buds and budding varies with conditions so much that no general rule can be given in this respect. Fall budding, allowing the buds to remain dormant until spring, has been frequently found to be satisfactory. As a rule, however, our observation has been that spring budding,

when the bark slips easily on the stocks, is safest, and likely, on the whole, to give the best results.

The character of the stocks to be used for the propagation of our best types of the Navel orange is probably more important than we realize. Unfortunately we have little information of value on this point. It is a safe plan, however, to use the kind of stocks which have heretofore given best results until some better stock is discovered and thoroughly tested. The inferior seedlings should be discarded and only the vigorous-growing and healthy ones used for budding work. The buds should be inserted fairly high in the stocks so that the bud union will not be buried when the young trees are transplanted.

To sum up: The conservation and improvement of the Washington Navel orange and other citrus varieties can be effected by the isolation and propagation of the best and most valuable types through bud selection based on performance records. The most effective means for determining the relative value of the types and of the individual trees in these types is performance records. In any event, any intelligent system of bud selection is better than none. The indiscriminate cutting of budwood and its propagation, for some one to grow and be disappointed with during long years, is little less than criminal, now that better methods have been tried and proven to be a success.

Breeding the Pecan

"My first successful work at tree breeding was in the union of the two best paper-shell pecan trees growing in San Saba County," writes E. E. Risien of San Saba, Texas, in the Proceedings of the National Nut Growers' Association. "The nuts of these trees were not large, but had qualities in them that I wanted to see blended." Cross-pollination in May, 1904, was interrupted by storms, but resulted in the production of fifteen nuts. "The best nuts are not found near the body of the tree in protected parts, so I didn't consider these fair samples. These fifteen nuts all germinated and grew. The mother was San Saba, the father tree Sloan. These fifteen little trees were not long in showing great variations both in growth and in the leaves. . . . The next year they were cut to the ground to get buds suitable for top-working. By managing them this way, possibly eight or ten years were saved in the time of fruiting. Anyway, I got to see sample nuts from the union of these two old trees, that were growing 27 miles apart, in five years from planting the seed. This little crop of nuts was an eye-opener, for they revealed to what extent those two trees bred back to the common wild types, which were mostly in evidence; and that the pollen proved to be the prepotent factor was also plainly shown, both in the character of the trees and in the nuts." Further crosses were then made; a combination of the varieties San Saba (seed-bearing parent) and Atwater (pollen-bearing parent) resulted in a lot of poor trees, but one prize, named Venus, a vigorous tree with large, highly colored nuts, which ripen a month later than either of the parents. "My third experiment was to use Texas Prolific for the mother tree, Atwater for the father tree. I have fruited a great many seedlings of the Texas Prolific fertilized by the winds and insects, all of which have been disappointing; but in fruiting the offspring from the union of these two trees the result was to get some prizes and many surprises. The perfect blending, however, I only found in one. It is a beauty; I have named it Banquet. It is large, too—very large; immensely prolific; ripens a week earlier than either parent, and retains that bright coloring characteristic of both sides. This alone gives it a distinction from the common herd. In fact, with this the 'razor-back' stock may now be considered pretty well bred out, and from the nucleus which I now have, it will take but another generation or two of our well-bred western nuts to invite criticism from the most fastidious."

CORRIEDALE SHEEP

Breed Now Being Tested in United States Is Result of Cross-Breeding in New Zealand 30 Years Ago—Breeds Remarkably True with Very Little Tendency to Reversion—Ancestral Characters Seem to Have Blended—How the Breed Originated.

F. R. Marshall

Senior Animal Husbandman in Sheep and Goat Investigations, Bureau of Animal Industry, U. S. Department of Agriculture, Washington, D. C.

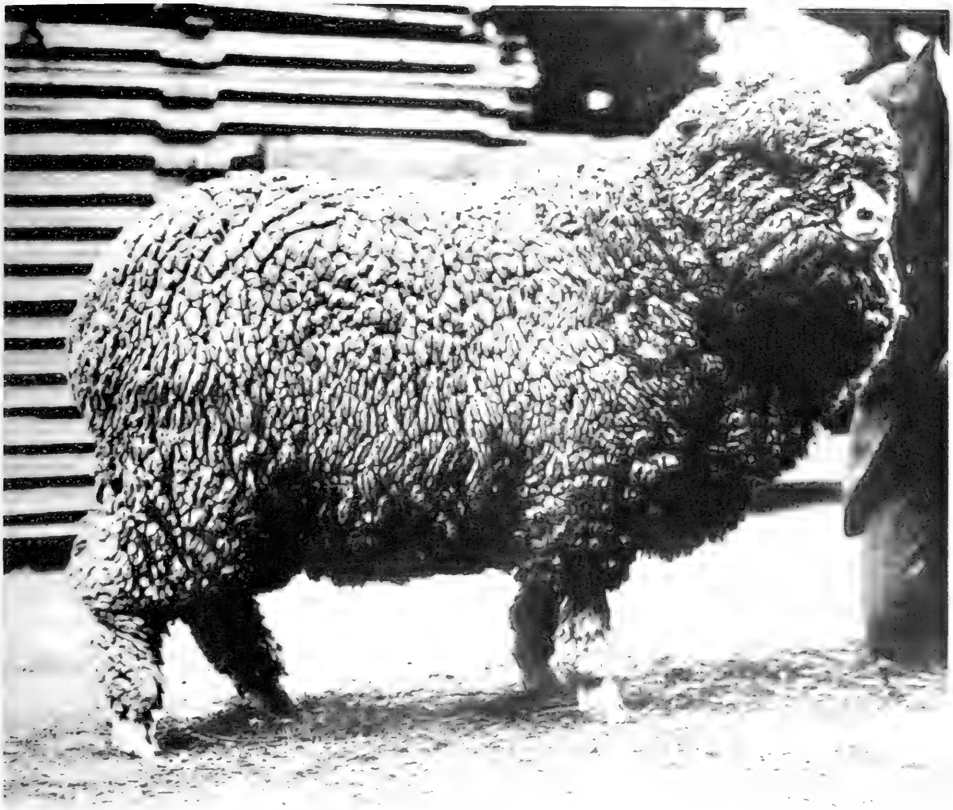
THE importation of seventy-five Corriedale sheep from New Zealand by the United States Bureau of Animal Industry a year ago has attracted considerable attention and well-meant criticism. Six head of Corriedales had reached this country a few months earlier than the Government's importation. The bringing of a trial importation of Corriedales at Government expense had been urged on account of the need of testing the breed's adaptability to Western State conditions before the making of private investments in stock of the breed. Although the ewes of this trial importation have done well during their six months stay on a Wyoming range, there has as yet been no opportunity to know the effects upon them of our rigid winter nor to see a twelve months' growth of wool under the conditions for which it was desired they should be tested. Nevertheless, during the past year three parties have imported other Corriedales to establish breeding flocks.

The demands of recent seasons for both wool and meat have greatly increased the popularity of the cross-bred range ewe. Rams of the long wooled breeds are preferred for crossing upon Merino ewes to produce the cross-bred stock ewe, on account of length and weight of fleece and the greater mature size over that of the cross-bred offspring sired by representatives of the down breeds.

It is surprising to find to what extent the cross-bred ewe is sought in territory commonly supposed to be the permanent and exclusive domain of the hardy and long tried Merino. This cross-bred ewe produces the class of wool that has been in demand in recent years; she has a greater marketable weight than the Merino ewe and her mutton qualities derived from her Lincoln or Cotswold sire add greatly to the carcass value of her offspring. The drawback of this ewe lies in the difficulty of perpetuating her type. A second or third cross of long wool blood obliterates the necessary herding instinct peculiar to the Merino alone. Crossing of Merino rams soon loses the size of carcass and the length and type of wool imparted by the long wool. In neither case can there be continued progress in bringing the flock nearer to the type approximately realized in the first cross.

VARIATION AND REVERSION

While the cross-bred ewe has been deemed a necessity, her brother, the cross-bred ram, has in the main been regarded as impossible for breeding purposes. The lack of uniformity in the offspring of cross-bred parents is well-known. The teachings of the new school of geneticists that has arisen since 1900 have reached the range sheepman, and while not understood have been regarded to a surprising degree. The proneness of the practical man to out-theorize the professional theorist is shown in his frequent adherence to the idea that the offspring of cross-bred parents always revert to

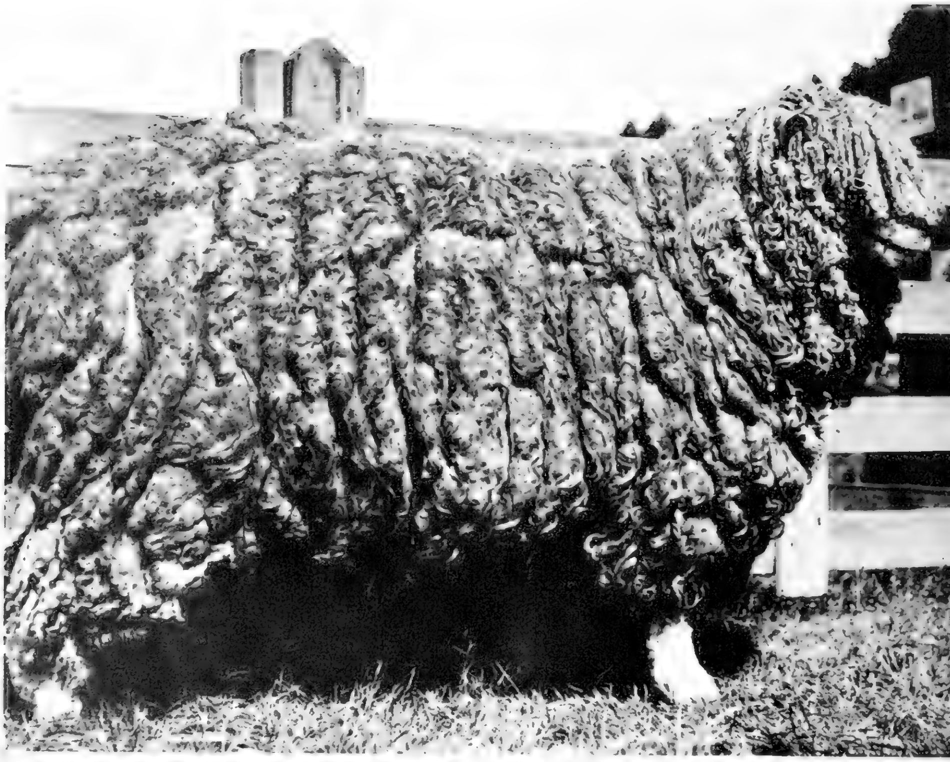


THE BASE OF THE CORRIEDALE BREED

Fine combing Merino ewe, champion in show of that type at Christ Church, New Zealand, 1914. The Merino is the most important fine-wool breed of sheep at the present time, but is inferior in meat production to some other breeds. New Zealand breeders a generation ago undertook to produce a new breed, which should be valuable for both wool and mutton, and they proceeded by crossing heavier types of sheep on the Merino. The ewe here shown is probably about the same type as that used in this very successful experiment. (Fig. 9.)

the original parental types, in spite of the fact that there is not wanting evidence of contrary results. Since market demands for meat have brought the carcass side of the range ewe into greater prominence a few western range operators have made use of first cross rams representing the type they desired in their ewe flock. Owing largely to the uncertainty of tenure upon grazing land, arising from the absence of any governmental public land policy, very few range sheep raisers are equipped to mate their ewes in enough separate groups to permit adherence to a definite and constructive plan. Little information can be obtained regarding the offspring of these cross-bred rams and there has been practically no progress toward fixing the type of sheep that was at hand, seemed certain to continue in demand, and had not been perfected in America or Europe.

In the Dominion of New Zealand however, sheep raisers of thirty years ago had met a condition and demand quite similar to that confronting western American pastoralists in more recent years. New Zealand's climatic and feed conditions are very favorable to the growth of a long stapled wool of fine spinning qualities. This fact, to-



ONE OF THE PARENTS OF THE CORRIEDALE

Lincoln sheep were crossed on Merinos in order to produce a breed that would unite the long fleece and large size of the Lincoln with the superior wool of the Merino. The Lincoln ram here shown is probably about the type used in the establishment of the Corriedale breed; he was champion at the Christ Church, N. Z., show in 1914. Owned by the New Zealand and Australia Land Company. (Fig. 10.)

gether with the extra weight of fleece procured from ewes having half long wool blood, gave rise to a good deal of crossing in the seventies before the meat trade had seriously affected the sheep husbandry of the island dominion. Later the establishment of the frozen meat trade increased the popularity of the cross-bred sheep and today New Zealand has less than 10% of Merinos among its flocks. The foregoing might be said to relate to the economics rather than to the genetics of the Corriedale but it sets forth the motives of the founders and the material used in forming the breed that has now reached the United States, South America, and Australia.

The Corriedale is a result of the original practice of crossing long wool rams upon Merino ewes. The problem before the New Zealand sheep raisers in the seventies and eighties was the same as that now interesting many western American flockmasters. The cross-bred ewe is a very useful animal but at present can only be secured by combination of two separate pure types. While many of the New Zealanders graded up their flocks by the continuous use of rams of the long wool breeds, others continued to breed half-bred rams on cross-bred ewes and a few conceived the idea of fixing the type of the first cross sheep. In less than forty years there has been produced a breed which, impartial critics state, exhibits fully as much uniformity of type as is found in most of the

ENGLISH LEICESTERS WERE USED TO SOME EXTENT

A few of the Corriedale flocks were founded by crossing English Leicester rams on Merino ewes, but as the Leicester is one of the parents of the Lincoln breed, the results from this cross do not constitute a very different element, in the Corriedale, from the results of the more frequent Lincoln X Merino cross. The above photograph shows a champion English Leicester ewe at Christ Church, N. Z., 1914. As the type of this breed has not been materially changed in the last thirty years, this undoubtedly represents very closely the animals that were used in the establishment of the Corriedale breed. (Fig. 11.)

older breeds, though not free from such differences representing ideas of individual breeders, as occur in all breeds.

Corriedales were first entered in the flock book of the New Zealand Sheep Breeders' Association in 1911. That year's volume of the flock book contains a brief history of seventeen Corriedale flocks including a total of 8671 ewes. Twelve of these make no mention of the use of any but Lincoln or Merino blood; five (containing 3400 ewes) show the use of English or Border Leicester rams at the outset with later partial use of rams from flocks bred from the Lincoln-Merino cross. It should be recalled that the English Leicester originally contributed largely in the formation of the Lincoln and Border Leicester breeds.

The following summaries of the histories of two flocks as printed in Vol. 7 (1911) of the flock book typify the work of Corriedale breeders up to 1911:

THE PROPERTY OF JAS. LITTLE

Dalmeny Park, Woodgrove, North Canterbury.

Mr. Little commenced experimenting with the view of producing inbred half-bred sheep when he was manager for the late Dr. Webster, proprietor of the Corriedale Estate, Otago. Romney Marsh and Merinos were first used; the result was entirely satisfactory, and would have been continued but for the decease of that gentleman and the sale of the property. On his taking up Allendale Estate, Waikari, Mr. Little continued to experiment.

In 1879-80 he put 4,000 large-framed high-class Merino ewes to Lincoln rams, bred by Mr. Sutton and some of the late Dr. Webster's strain. From 100 of the best ram lambs, the progeny of these ewes, a heavy cull was made, when twenty of the best were retained for service. These were mated with a pick of the half-bred ewes, the progeny of the Merino

YEARLING CORRIEDALE EWES, NOT YET SHORN

From a mixture of Merino, Lincoln and English Leicester sheep, shown in the three preceding illustrations, has resulted a new breed that is already well fixed and breeding as true as most breeds do. The representatives shown in the above photograph are owned by Leonard White, of Rakia, N. Z., and include the first prize single ewe and first and second prize pairs at the Christ Church show 1914. In a breed established so recently, from such diverse elements, it would be expected that a great deal of reversion to parent, types would manifest itself, and that it would be difficult to get a large proportion of the lambs true to standard. Such has not proved to be the case, however, and the Corriedale therefore presents to geneticists an extremely interesting instance of "blending inheritance." (Fig. 12.)

ewes, and Sutton and Webster rams, the result being a very high class type of half-bred sheep. In 1890 two rams bred by Mr. Tanner, from Merino ewes and Lincoln rams, were used, but the result was not considered satisfactory. About the same time twenty stud Merino ewes were purchased from Mr. D. Rutherford and the same number from the Horsley Downs Flock. By this means fresh blood was procured and was kept going on the line breeding until 1902, when a Corriedale ram was procured from Mr. Jas. Stringfellow. In 1909 a ram was used bred by New Zealand and Australian Land Company (Moeraki Estate). The rams used in the flock with these exceptions have all been descended from "Old Jonathan," bred by Mr. Little twenty years ago.

In 1903 the flock was transferred from Allendale to Dalmeny.

Returns for 1911.

Ewes put to ram in 1911, 858.

Ewes, four-tooth and upwards	598
Shearling ewes	260
Total	858

Lambs bred in 1910—rams, 421; ewes, 483.
Sires used in 1911, bred by owner.
Rams sold—two-tooth, 131.

THE PROPERTY OF THE NEW ZEALAND AND AUSTRALIAN LAND COMPANY LTD.

Moeraki Estate, Hampden, Otago.

This flock was founded by Mr. W. S. Davidson, at the New Zealand and Australian Land Company's Levels Estate in 1874. One thousand Merino ewes were put to Lincoln rams, and out of the produce of these ewes 150 half-bred ewes were selected for mating with rams, also out of the same ewes.

Since 1874 the progeny of these ewes have been in-bred with rams out of the same flock. The only outside blood introduced being a ram bought in 1892 from Mr. Tanner, Hawke's Bay (who had then an in-bred flock started about the same time as the Levels Estate Flock), and one ram from Messrs. Reid Bros., Darfield, in 1902, but these two rams were very slightly used. In 1904, when the New Zealand and Australian Land Company gave up the Levels Estate for closer settlement, some of the Levels Estate Corriedale Flock was transferred to the New Zealand and Australian Land Company's Moeraki Estate at Hampden, where its breeding has been continued on the same lines as in previous years, and no outside blood has been introduced into the flock since it was transferred to that property.

Returns for 1911.

Ewes put to ram in 1911, 502.

Ewes four-tooth and over	391
Shearling ewes from own flock	111
Total	502

Lambs bred in 1910—rams, 231; ewes, 257.
Sires used in 1911, bred by owner.
Rams sold—two-tooth, 223; four-tooth, 4.

The above entries show the common form of entry in the New Zealand flock book. The number of ewes bred, the origin of the sires and number of lambs raised and sold constitute the only facts recorded.

Admission of a flock to the book of record is conditional upon approval of an examining committee who regard merit and uniformity and may require the disposal of some animals before accepting the flock for record in the flock book. Most of the flocks accepted so far have been bred along the same line for from twenty to forty years. There is no regulation as to the number of generation necessary for admission to record. Continuous use of the offspring of youngest ewes would permit securing ten generations in twenty years but it never happens that all ewes are discarded after producing their first lambs. The bulk of a thirty-year-old Corriedale flock in New Zealand probably have back of them ten or twelve generations of descendants of the original crosses. One or two breeders made a special claim of having added fixity of type by always using the youngest rams available in order to increase the number of generations of selected ancestry. None of the private records permits of tabulating pedigrees to show dams for more than one or two generations, consequently Corriedale history must be read in rather a general way. The organization of Corriedale breeders recently formed in Australia requires that before being admitted to the flock book, flocks must be inbred half-breds for at least nine generations after the Lincoln-Merino foundation cross-breds. In case of breeding Corriedale rams upon half-bred ewes, six generations suffice.

It required no experiment to secure the desired type in establishing the Corriedale. The problem was entirely one of giving fixity to a type produced by crossing. The Lincoln and such English and Border Leicesters as were used may be regarded as practically of one type for consideration in this connection. The English Leicester was developed solely by selection, as its founder, Robert Bakewell, could draw

CORRIEDALES IN AUSTRALIA

Part of a newly founded flock in New South Wales. One of the most valuable characteristics of the Merino breed is its "herding instinct" which prompts the animals to keep together, and makes them manageable by shepherds. This instinct has been retained, it is said, in the Corriedale, and is a feature of great value to the new breed. (Fig. 13.)

upon no highly improved mutton sheep in the last half of the eighteenth century. In ancestry and in many commercial characteristics the Merino is about as dissimilar to the long wools as can be found without going to the central Asiatic types.

CONSTANT CULLING

The main work of the New Zealand Corriedale breeders seems to have been in the culling of rams and ewes. As shown in Mr. Little's flock, twenty ram lambs were retained from the offspring of 4,000 ewes. At the Moeraki estate 150 ewes were selected from the progeny of 1,000 ewes. Such vigorous culling surely allowed uniformity. We have no records as to the percentage of discards from the second and subsequent generations, but 1911 reports indicate that culling is not light as the number of yearling ewes is not far below half that of the older ones. From my observations on New Zealand farms I did not conclude that Corriedale breeders now cull heavier than owners of flocks of other breeds. The vigorous culling in the earlier stages need not be taken to show particular clearness of aim on the part of the breeders, as it is doubtful if they then looked forward to the status of a breed. Sheep were cheap and the best of the half-breds were retained in a separate flock as the most logical method of obviating the need of pure long wool and Merino flocks to produce fresh stock ewes. The discards were sold or used with rams of the common breeds.

The fact that many of the opposed characters of the Lincoln and Merino appear to have blended and that the blended form is now uniformly transmitted does not harmonize with present day understanding of the probability of segregation of the factors composing a character. With coat characters such as length and fineness of fiber so opposite as they are in the Lincoln and Merino, one might expect here at least frequent

reversions to the length or to the fineness of one of the parent stocks. Among the several hundred Corriedales I saw and the scores I examined closely not one had wool anywhere nearly as short as the longest wooled Merinos, as coarse as the Lincolns, or as fine as the Merino. Many of the lots examined were either ram or ewe hoggets that had not been culled, consequently it could not have been that reversions had occurred and been discarded. These characters may be determined by a number of factors each separately heritable but their number and irregularity of transmission must be beyond hope of elucidation or practical control. In length of wool fiber Corriedales more nearly approach the Lincoln than the Merino, though I cannot say that any I saw fully equalled in this respect Lincolns grown under similar conditions.

HORNS STILL APPEAR

The horned character still crops out quite frequently, one breeder having stated that 5% of his 1914 lamb crop were culled because of horns, which could only have come through the female line as both sexes of the original crossbreds were from the hornless Merino ewes and Lincoln rams. Horns in the long wool breeds are of exceedingly rare occurrence.

Body characters are less easily followed than those of fleece. The most common conformation of the Corriedale is practically intermediate between the Lincoln and Merino in respect to width of back and loin, depth of body and development of the rump and twist. In some flocks where fineness of wool has been emphasized, the narrower chests and the throat folds of the Merino are seen, though none of the sheep examined after shearing could be mistaken for either Lincoln or Merino by anyone familiar with these breeds.

The comparative newness of the Corriedale and the fact that it does not come from Europe have called forth considerable argument against the possibility of the breed's being of a fixed type. Strangely enough the fact is overlooked that at least one of the British breeds now quite popular here was originated by crossing animals from two distinct breeds, and most of the other breeds of sheep at some stage of their existence have received the impress of older breeds and have been rendered true to a type embodying characters of the outside blood.

Peacock-Guinea Fowl Hybrids

The cross between pea fowl and guinea fowl is a very "wide" one that has been made a number of times. The latest recorded success is that described by D. Brentana in the *Moderno Zooiatro*, No. 11, 1914. In general appearance the hybrids most closely resemble the peacock, their form being slender, particularly in the head and neck, although there was a noticeable absence of all the characteristic appendages of the head, and the great train of feathers which is the peacock's pride was very much reduced. The plumage exhibited striping, which is perhaps a primitive pattern in the pea cock. It was of a dark fawn with black stripes in the lower part of the neck, becoming paler fawn with black specks in the region of the thorax, abdomen and flanks. As such hybids are usually absolutely sterile, it is impossible to breed them through several generations and work out the manner of inheritance of the various characters involved.

SUGAR CANE THAT OUTGREW ITSELF

An unusual abnormality in sugar cane is shown in the accompanying photograph from H. B. Cowgill, plant breeder of the Insular Experiment Station, Rio Piedras, Porto Rico. "This stalk," he writes, "was taken from a seedling cane which was grown here in the year 1913. The photograph shows four complete internodes or joints of a stalk; each of these joints has, as usual, a bud growing from it. But in every case, it will be observed, this bud is transversed squarely across the middle by a great fissure. All the stalks of this seedling showed this abnormality on many of the internodes. As may be seen, it is a rupture of the outer portion of the stalk across the center of the bud. Seedling canes frequently show peculiarities, but this is the first time I have known this particular abnormality to happen. It seems to have been caused by an unusual formation of the bud. In sugar cane the point of the bud is usually free from the stalk, but in this case it adhered closely to the stalk and seemed to have grown fast to it. The bud within evidently developed faster than the stalk, while its outer scales could not do so on account of being fastened to the latter. The pressure produced seems to have been sufficient to rupture the stalk. It was not possible to make any test to determine whether this abnormality would be inheritable." (Fig. 14.)

The

Journal of Heredity

(Formerly the American Breeders' Magazine)

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CONTENTS

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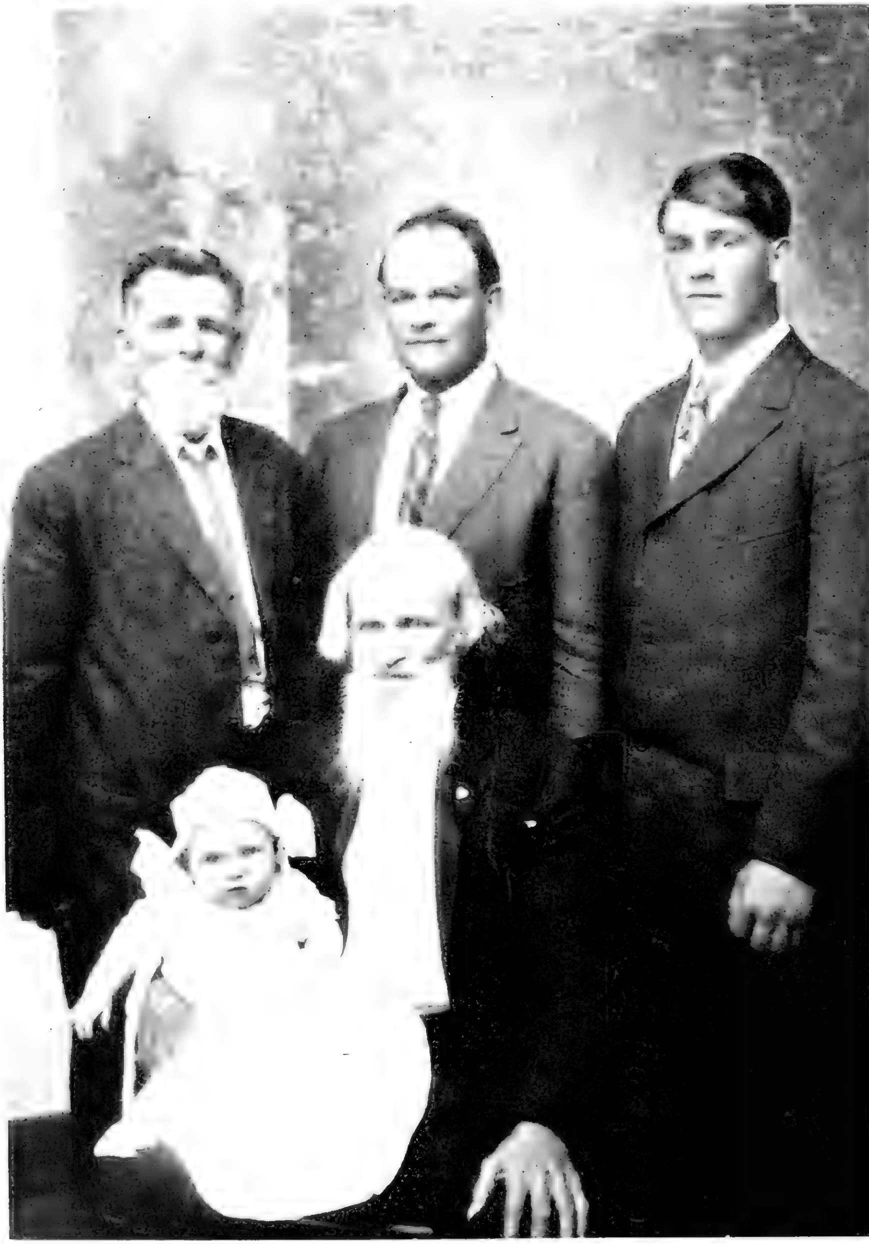

HE HAS 101 DESCENDANTS

Dr. Harvey C. Hullinger of Vernal, Utah, was born in Ohio in 1824; he is, therefore, only 92 years old. His father died at 40 and his mother at 44; nevertheless, the stock from which he comes is a long-lived one, his brothers, sisters, uncles, aunts and grandparents having mostly lived far beyond the usual span. The photograph shows five generations of a single family, the ages of the younger members being: W. S. Hullinger, 68; W. S. Hullinger, Jr., 46; Harvey Hullinger, 20; Wynona Murray Hullinger, 7 months. Photograph taken September, 1915. Dr. Hullinger married three times, and has 14 children, 22 grandchildren, 63 great-grandchildren and 2 great-great-grandchildren. Photograph from the Geneaogical Record Office, Washington. (Frontispiece.)

LONG LIFE MEANS MANY CHILDREN

And Long Life Also Means a Good Inheritance Study of Longevity Brings Important Proof to the Theory of Evolution

Plymouth, N. C., Dec. 3.—W. B. Davis, 94 years old and father of 41 children, 33 of whom are alive, got a license Wednesday to wed a Mrs. Mason, 39 years old, who lives near here.

The ceremony was performed yesterday. Twenty-five children and more than a hundred grandchildren of the bridegroom attended.

Mr. Davis has 192 grandchildren and a number of great-grandchildren. This is his fourth venture in matrimony. He is enjoying health, but has complained of being lonesome.

LONG-LIVED parent—many children: the connection seems too obvious to be worth noting.

But it is very well worth noting. The simple fact illustrated in the above newspaper clipping means a great deal not only to eugenics, but to the whole theory of evolution.

First let us make sure of our facts. If we pick at random from the death records the names of two women, one of whom died at the age of 50 and the other at the age of 75, will the longer-lived be found to have left the larger family? Both of them, you must notice, lived past the reproductive period, and it might be supposed that after that period a few years more or less could make no difference.

Nevertheless, the study of Karl Pearson and his associates[1] leaves no doubt that the longest-lived parents have the largest number of offspring. They were able to study family records of some thousands of English and American Quaker families, and reached this conclusion:

"Fertility is correlated with longevity even after the fecund period is passed. If we take American mothers there is no doubt of this increasing fertility even up to 90 years of age. With English mothers it is less marked, but appears to be quite true up to 75 years. Beyond 75 there appears a slight decrease."

In other words, the peculiar physique, the vitality and the toughness of constitution in both men and women, which make longevity possible, are also associated with fecundity. Where you find one, you are likely to find the other. Of two women who both live beyond 50 years, the longer lived is likely to have had, before 50, the larger number of children.

It is not easy to understand why this condition should be more marked for American parents than for English parents, for the American families dealt with were, in the great majority of cases, of Anglo-Saxon race. Evidently climate, mode of life, and similar influences are bringing about a difference in this respect, between the English and the Anglo-American stocks.

Remembering that long life is associated with numerous offspring, let us now recall that long life is due primarily to heredity. Contrary to what one might suppose, people do not attain to a great age because of any particular habits of life, any particular kind of diet or brand of beverage. They live long because they come of a long-lived stock, because they have inherited the kind of constitution that, in circumstances which are reasonably favorable, will stand the strain of existence for an unusually long time.

We are now in a position to see how the connection between long life and large families will assist us in understanding how evolution works.

In the first place, Darwin and many others have shown that the members of a race least fitted to their surroundings are removed by death. For example, of two children born in a neighborhood where tuberculosis is abundant, the one with an inherited resistance is pretty

[1] On the Correlation between Duration of Life and the Number of Offspring. By Miss M. Beeton, G. U. Yule and Karl Pearson. Proc. R. S. London, 67 (1900), pp. 159-171.

DESCENDANTS IN FOUR GENERATIONS

Mrs. Mary Erickson of Stahl, Mo., was born in Kentucky in 1821, and is therefore 95 years old. She is the eldest of 11 children, the rest of whom died at from 50 to 60 years of age. Her father died at the age of 56 and her mother at 57. She is, therefore, well above the average longevity of her family a fact which may be due partly to the more remote ancestors, but which she attributes to hard work plain food and regular habits. The photograph (from the Genealogical Record Office, Washington) shows her with her eldest son, eldest grandson, eldest great-granddaughter and eldest great-great-granddaughter. (Fig. 1.)

sure to live longer than the one who lacks an inherited resistance.

But if each of them survived to adult life and left an equal number of children, it is obvious that the character of the race would not be changed—there would be relatively just the same numbers of weak and strong persons (in respect to tuberculosis-resistance) in it in the next generation, that there are in this.

The theory of natural selection requires that the weaker of the two individuals whom we have picked out for an illustration, must leave fewer offspring than the strong one. The less fit must leave fewer descendants than the more fit. Thus the race progresses a little in each generation, in the direction of greater fitness in this respect.

THEORY CONFORMS TO FACTS

The theory requires, we have said, that there be this difference in fecundity. But do facts back up the theory? We have reached a point in the study of evolution where we are tired of theories. We want facts.

Sometimes we can get them; sometimes we can not. In this particular case a study of long-lived people gives us exactly the information that we needed and expected. As we have seen, the long-lived—who must be considered to be in generally an unusually *fit* lot of people—are found to have more offspring than the shorter-lived and less fit. And since this fitness is, as we know, hereditary, it follows that the race should be getting a little more fit in this respect, with each generation, because the amount of inherited longevity must be greater than it was in the previous generation.

The lonesome and fatherly Mr. Davis, cited in a newspaper story at the beginning of this article, may or may not exist in real life. But if he does not, it would not be difficult to find some one else conforming to the same specifications; for long life *does* mean a large family. We have been able to measure the exact amount of association between the two facts, and thus add another piece of mathematically demonstrated proof to the theory of evolution which Darwin left us.

Modes of Research in Genetics

MODES OF RESEARCH IN GENETICS, by Raymond Pearl, Biologist of the Maine Agricultural Experiment Station. Pp. 182, price $1.25. New York, the Macmillan Company, 66 Fifth Avenue, 1915.

The principal and most useful part of Dr. Pearl's book is a discussion of the relative merits of the two principal methods used in studying heredity—namely, the biometric and the Mendelian. Public opinion is still confused as to the respective spheres of these methods, as a result of the conflict between them which raged a few years ago. Advanced students now generally recognize that each of these methods has its place, and also its limitations; but the beginner, who frequently reads the literature of a decade ago, is too often confused by the recriminations and denunciations he finds. Dr. Pearl shows clearly just what each method can do, the biometric method being essentially the study of the ancestry of an individual, while the Mendelian method is the study of the posterity of an individual. A perusal of this book will do much to clear up the ideas of a great majority of those who are actively interested in genetics. The problem of inbreeding, and the general relation between practical breeding and experimental genetics, are also discussed.

Journal of Heredity As Text-book

The class in heredity at the Ohio State University is now using the JOURNAL OF HEREDITY as its text-book, arrangements having been made for a special short-term membership in the American Genetic Association, for each of the twenty-two students taking the course.

INCREASING FECUNDITY

Remarkable Effect of Pituitary Substance on Poultry May Have Wide Application Great Increase in Egg Production and Hatchability of Eggs Obtained

FECUNDITY is one of the most important factors in the practical application of genetics, whether it be in eugenics or animal-breeding.

Any method of increasing the fecundity of valuable strains would be of great worth to the eugenist and the breeder.

One such method seems to have been found by Lewis Neilson Clark, of Oldham Farm, Port Hope, Ontario, Canada, a member of this association who has been experimenting with the ductless glands of animals, by feeding extracts of them to chickens. By the use of an extract of the pituitary gland, he has increased the egg production of hens, sometimes nearly doubling it, and at the same time has secured an increased "hatchability" of the eggs.

The pituitary gland of calves, secured by Mr. Clark from his local butcher, is a small rounded body attached to the under side of the brain, and consisting of two lobes, an anterior and a posterior. It is generally supposed to regulate, by its secretions, the nutrition of bone and other connective tissue, and to have many other far-reaching influences on the entire body. For the experiment here described, Mr. Clark used only the anterior lobe of the gland, which he ground up and mixed with sugar of milk to form a paste. This paste was dried at room temperature, ground to a powder, and weighed, the loss in weight amounting to 13.5 per cent. In the experiments recorded below 69 milligrams of this powder, representing 20 milligrams of fresh pituitary substance (anterior lobe), were administered to each hen per day.

RECORD OF HENS KNOWN

"The first experiment attempted," Mr. Clark writes,[1] "dealt with thirty-five Single Comb White Leghorn hens hatched in April, 1913, mated, in two pens, to two cockerels of the same breed, hatched in May, 1914. These two pens were housed in two colony-houses, on free range, and had been used as breeding-pens for this season's work before the dosing was commenced. I have, therefore, records of their egg production for several months previous, the laying being very steady and consistent. For the purpose of illustrating the results of this experiment, it will be necessary to give only the egg production for a period of fourteen days prior to first dosing. It will be noted in Table I[2] that the production curve was declining, previous to dosing, this being only natural in view of the heavy and consistent laying of these hens since February. Both hens and cockerels were forcibly fed at night time with the powder, enclosed in gelatin capsules, the dose in each case being 69 milligrams. The first dose was given on the evening of May 20 and the last dose on the evening of May 28. A remarkable increase in production

[1] The Effect of Pituitary Substance on the Egg Production of the Domestic Fowl. By Lewis Neilson Clark. *Journal of Biological Chemistry*, Vol. XXII, No. 3, pp. 485-491; October, 1915.

[2] The table is too long to be reprinted here. A summary is as follows:

First dose evening of May 20. Last dose evening of May 28.

Average daily egg production of experimental pens May 7 to May 14, inclusive, 19.25 eggs = 55 per cent possible.

Average production May 15 to May 23, inclusive (to 3 days after first dose), 16.11 eggs = 46 per cent possible.

Average production May 24 to May 30, inclusive (from 3 days after first dose to 2 days after last dose), 32 eggs = 91.43 per cent possible.

Average production May 31 to June 6, inclusive, 21.57 eggs = 61.63 per cent possible. The pens were broken up on June 7.

was noted on the fourth day after the administration of the first dose, but was apparently dropping back to normal when, owing to the exigencies of the management of a large poultry farm, it was necessary to break up these isolated pens. The hens were kept under close observation for a period of one month after the last dosing and their general health continued exceptionally good, there being not one case of sickness or death among any of the subjects, and the general appearance of the birds being far above the average for this season of the year.

A CHECK ON THE RESULTS

"I felt sure that the marked increase shown in the production of these hens, whose laying had been most consistent and whose production curve was on the decline at the time of experiment, was due solely to a direct stimulating effect on the ovaries, produced by pituitary substance, and to no other causes. A 100 per cent egg production is almost unknown in my experience, at this season of the year, especially with flocks of this size (seventeen and eighteen in a pen). The conditions for egg production were practically ideal, but the same conditions, and very much the same weather, had obtained for a month previous. In order to meet the natural query as to whether the weather or other conditions might not have influenced the production of the experimental fowl, the daily egg records of two large laying pens were studied and are given in Table I for comparison.[3] Conditions in these two pens and in the experimental pens were very similar. Feeding conditions, weather, and the nature of the soil were identical, the only difference being in the fact that the experimental pens were in small isolated houses, on free range, whereas the large flocks were in long continuous laying-houses each with a fenced-in run of three and one-half acres of land.

"In order to test the effect, if any, on the hatchability of the eggs and the viability of the chicks, 100 eggs from the experimental fowl were collected previous to dosing—that is, from May 14 to May 20—and were set in an incubator on May 20, the eggs being from two hours to six days old. On the fifth day after the first dose, eggs were again collected from the same fowl, 100 eggs being gathered from May 26 to May 28, and were set in an incubator of the same make on May 29, the eggs being one to three days old. The results of these hatches are even more remarkable than the increased egg production, as is seen from Table II.[4] Prairie State Sand Tray Incubators of the same size were used. Conditions of temperature were closely regulated by thermostats. In both experiments the temperature ranged from 102–103.5° F., as required to give the best conditions for hatching. The chicks are being kept under observation to note sex and any peculiarities of growth.

TEST ON LARGER SCALE

"Feeling it desirable to have a further experiment to more fully prove the effect of this substance, I determined to dose all the hens in one of the large laying-houses. The house so chosen contained 655 one-year-old Single Comb White Leghorn hens (no males), and the dose administered to them was 45 grams of the powder per day. Owing to the large scale on which the experiment was being conducted, it was only possible to obtain sufficient material for four daily doses. It was unfortunate that the dosing could not be continued over a longer period, but the results obtained from these few doses were so marked and striking as to leave no doubt as to the stimulating effect of

[3] For the corresponding periods, the laying record of a flock of 657 hens was as follows:
May 7 to May 14, inclusive, 45 per cent possible.
May 15 to May 23, inclusive, 45 per cent possible.
May 24 to May 30, inclusive, 44 per cent possible.
May 31 to June 6, inclusive, 44 per cent possible.

[4] Of the 100 eggs set before dosing, 6 were infertile and 8 showed dead germs; 15 chicks died in shell (7 pipped); 71 hatched.

Of the 100 eggs collected after dosing, 0 were infertile, 0 showed dead germs, 4 died in shell (all pipped), 96 hatched.

the pituitary substance (anterior lobe) on the egg production of the domestic fowl.

"As will be noted in Table III,[5] in the preliminary period, the production curve of these 655 hens was again, in this case, on the decline. In order to show that weather or other conditions did not apparently tend to increase production on these dates, I have again given (in Table III) the daily egg record of the flock of 431 hens. It will be noted in this case that the stimulating effect on the 655 hens lasted only about seven or eight days after the last dosing, but it will be seen that the total dose administered only provided, during the four days, the equivalent of 80 mg. of pituitary substance per hen and there is no assurance that the material was equally divided among the hens. It being impracticable to forcibly feed so many hens, the following method was employed in this case: 45 grams of powder were divided into three equal parts, each part thoroughly mixed into a pailful of dry mash. This mash was then moistened with sour skim milk and fed to the hens. The same quantity of this same moist mash had been fed to these hens every day for months past. It had been mixed in exactly the same way except for the addition of the pituitary substance, and feeding conditions and general care were identical during the experiment with conditions previous, as far as it is possible to make conditions of this kind identical. It was noted that on the second day after dosing, these hens required, and were given, a larger allowance of grain than previously, and the dry mash being always before them in open feed hoppers, it is probable that they consumed a greater quantity of this material than under normal conditions. The increased appetite was undoubtedly occasioned by the increase in production, the writer having often noted the fact that a sudden increase in the appetite of a flock is usually a precursor of an increase in egg production.

"I am publishing this paper as a preliminary report. Further experiments will follow to determine:

"1. The post period during which the stimulating effect lasts.

"2. The smallest dose producing the desired results.

"3. The general health, growth curve, and age at maturity of chicks from dosed parents.

"4. A comparison of the effect of pituitary substance taken from growing mammals and from adult mammals.

"I have other experiments under way at the present time.

"At the time these two experiments were completed I did not know that work of a similar nature had been done by Pearl and Surface. These two observers administered the pituitary substance hypodermically to hens whose ovaries were in a state of complete rest (at the moulting season). They found no activation, but their experiments were carried out under very different conditions, as regards the physiological condition of the subjects, the method of administering the substance, etc. It seems possible to me that the negative results they obtained as compared with my positive results might be explained by the fact that the pituitary substance I used was from growing mammals while it is probable that their material was from adults, as it was purchased from the Organotherapeutic Laboratory of Armour & Company. It is known from the work of McCord that positive results are obtained from the use of pineal body from growing mammals, and negative results from this substance taken from adults, and the same may be the case with pituitary gland. Experiments are in progress to test this point.

"These experiments show that:

"1. Feeding of pituitary gland sub-

[5] Average daily egg production of fowls:
June 1–8: Experimental pen 45 per cent possible, laying-house 40 per cent.
June 9–17: Experimental pen 38 per cent, laying-house 38 per cent.
June 18–24: Experimental pen 36 per cent, laying-house 36 per cent.
June 25–July 1: Experimental pen 51.78 per cent, laying-house 35 per cent.
July 2–11: Experimental pen 39.14 per cent, laying-house 31 per cent. The first dose was given to the experimental pen on the afternoon of June 21 and the last dose on the afternoon of June 24.

stance (anterior lobe) increased the egg production of hens whose production curve was on the decline: Case 1, with 35 hens in isolated pens; Case 2, with 655 hens.

"2. The dosage was effective on the fourth day after the first dose and lasted for several days after the last dose.

"3. The hatchability of eggs from dosed parents was increased."

Heredity and Criminal Delinquency

Heredity is considered only a minor cause of delinquency by William Healy, director of the Juvenile Psychopathic Institute of Chicago, who presents an analysis of 823 individual cases in his recent book "The Individual Delinquent." Mental abnormalities and peculiarities appear as a main factor 455 times and as a minor factor 135 times; but Dr. Healy apparently does not consider such abnormalities to be the equivalent of bad heredity. "Defects of heredity" are noted in no case as a main factor, but in 502 cases as a minor factor. Other causes listed by Dr. Healy, such as "abnormal physical conditions," "defective home conditions, including alcoholism," would be thought by many students to be largely due to defective heredity; and to heredity, therefore, might well be ascribed a much more important rôle in the production of criminal delinquents, than Dr. Healy gives to it, if one used the same facts but started with a different viewpoint or different definitions.

An Outline of Eugenics

BEING WELL-BORN, by Michael F. Guyer, Professor of Zoology at the University of Wisconsin. Pp. 374, price $1.00. Childhood and Youth Series. Indianapolis, Bobbs-Merrill Company, 1916.

The field of heredity in man is resurveyed by Dr. Guyer in a compact volume which omits few topics of importance. The study of the cell and the mechanism of heredity are given much space, and methods of cutting off defective lines of descent are also dealt with at length. Less attention is given to constructive eugenics than one might wish, but the recommendations made are sound and conservative. A full glossary adds to the value of the volume. In the highly controversial field of Mendelism the author's conclusions will not always be accepted by other students, but this is a detail which detracts little from the general soundness of judgment shown. A comparison of Dr. Guyer's book with those on similar subjects by other authors will convince anyone that there is substantial agreement between those who have studied the problem from various angles, in regard to what eugenics can and cannot do.

Eugenics in Hungary

An organization for Race-Hygiene (Eugenics) exists in Hungary since two years. Instead of founding a new society, existing societies prominent in social and medical work organized a common Committee for Race-Hygiene in Budapest, on February 25, 1914, under the leadership of Count Paul Teleky and Professor Apáthy. There is no special organ for publications as yet, but the Hungarian Sociological Review has a permanent column for topics of Race-Hygiene. The work was started with the government taking much interest in it, when the war broke out and stopped further activities except an action to repress venereal diseases in the army.

G. VON HOFFMAN, Berlin.

PATROGENESIS

A Form of Inheritance with the Characters of the Female Parent Completely Excluded—A Cross Between Two Genera of Grasses, Tripsacum and Euchlaena[1]

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INTRODUCTION

A FERTILE hybrid between *Tripsacum dactyloides* L. and *Euchlaena mexicana* Schrad., was reported by the writers in 1914. The behavior of the single first generation plant was at that time described and its close resemblance to the male parent noted.[2]

It is now possible to report the behavior of the progeny of this hybrid plant, which have been grown for two seasons, and to make comparisons with the first generation plant and with the parents.

The parental stocks were *Tripsacum dactyloides* and *Euchlaena mexicana*. Tripsacum is a perennial grass native in many parts of eastern United States and is of no economic importance. Euchlaena is an annual grass native in Mexico and frequently grown in the United States for forage under the name of "teosinte." These species not only belong to different genera, but are placed in separate groups of the tribe Maydeae. The two genera, together with Maize or Indian corn, are the only American representatives of the tribe. The plants differ profoundly in general appearance, as well as in structural details, as the illustrations show.

The list of contrasted characters given on the opposite page will serve to indicate the more conspicuous differences.

The plant of Euchlaena used as the male parent in the hybrid was from seed received from Dr. H. V. Jackson, of Durango, Mexico. Euchlaena is reported as a wild plant about Durango. It is also cultivated in the same region. The cultivated form, at least, is much hybridized with maize. Plants representing all stages from what appears to be pure Euchlaena to those that closely resemble pure maize have been grown from original seed received from that region.

The fact that the particular plant used as pollen parent of the cross was grown in the greenhouse, where Euchlaena plants never behave normally, made it difficult to determine whether this plant shared any of the frequent contamination with maize. The plant was stunted and somewhat abnormal, but no maize characters could be observed, and there has been a similar absence of maize-like characters in the pure seed progeny of the hybrid plant. It is, therefore, believed that the male parent of the hybrid represented a relatively pure form of Euchlaena.

DESCRIPTION OF SUPPOSED HYBRID

The original cross was made in March, 1913, in a greenhouse of the Department of Agriculture at Washington, the Euchlaena pollen being placed on the stigmas of a plant of Tripsacum. Precautions were taken to guard against foreign pollen, although no other Tripsacum plants were growing in the greenhouse and no pollen was yet being produced on the plant that was fertilized, Tripsacum being decidedly proterogenous. The cross was such a violent one that there was little expectation of success, but four seeds developed and these were planted as soon as mature. When a sprout appeared above

[1] Read before the twelfth annual meeting of the American Genetic Association, at Berkeley, Cal., August 6, 1915.

[2] Collins, G. N., and Kempton, J. H., A Hybrid between Tripsacum and Euchlaena. *Journal Washington Academy Science*, Volume IV, No. 5, pp. 114-117, March 4, 1914.

TRIPSACUM DACTYLOIDES	DURANGO EUCHLAENA
Plant perennial.	Plants annual.
Staminate and pistillate flowers in the same inflorescence.	Staminate and pistillate flowers in different inflorescences.
Terminal inflorescence with from 1 to 3 branches.	Terminal inflorescence with from 8 to 20 branches.
Branches of terminal inflorescence erect.	Branches of terminal inflorescence drooping.
Branches of terminal inflorescence without pulvini.	Branches of terminal inflorescence with pulvini.
No secondary branches in terminal inflorescence.	Secondary branches in terminal inflorescence equalling or more numerous than the primary.
Staminate spikelets in pairs both sessile.	Staminate spikelets in pairs one sessile, the other pedicelled.
Staminate spikelets in alveolae.	Staminate spikelets not in alveolae.
Pistillate inflorescence naked.	Pistillate inflorescence enclosed in bracts.
Outer glume of pistillate inflorescence completely exposed.	Outer glume of pistillate inflorescence partially enclosed by the rachis.
Stigmas about 2 cm. long.	Stigmas from 10 to 15 cm. long.
Stigmas divided to the base.	Stigmas divided for about 3 mm.
Inflorescence basipetal.	Inflorescence acropetal.
Fruit trapezoidal.	Fruit triangular.
Rachis not constricted between the seeds.	Rachis constricted between the seeds.
No branches in axils of prophylla.	Branches in the axils of prophylla.
Leaf blades about 50 times as long as wide.	Leaf blades about 10 times as long as wide.

the surface of the ground our faith was still so small that the plant was dug up and the seed examined to make sure we were not rearing a "cuckoo." As the sprout was found to be growing from an unmistakable Tripsacum seed, it appeared certain that the plant was either a hybrid or a parthenogenetically developed Tripsacum. The second alternative was soon dismissed, for Euchlaena characters appeared with the first leaves, and the further stages of development were those of a nearly normal Euchlaena plant. Most careful scrutiny failed to disclose any characters that could be referred to Tripsacum, the female parent. The plant was not exactly like others that had been grown previously, but even under the most favorable greenhouse conditions, Euchlaena shows many deviations from the normal behavior. The deviations in this were not extreme or unusual, indeed the plant was more nearly like normal Durango Euchlaena than any Euchlaena we have ever been able to grow under greenhouse conditions.

Two points regarding this cross should be kept in mind: (1) the plant was known to have grown from a seed borne on a Tripsacum plant; (2) the plant resembled the *male* and not the female parent. These two facts taken together eliminate all questions of foreign pollen or faulty technique.

The plant was grown to maturity in the greenhouse, was carefully guarded and self-pollinated and produced a quantity of seed. Unfortunately no Tripsacum pollen was available at the time the first generation plant was in flower, October, 1913, but plants of a Florida Euchlaena were just beginning to shed pollen and this was applied to a number of the pistillate inflorescences. Two very late varieties of tropical corn were also in flower and pollen from them was similarly used. All the pollinations were successful, seed setting as readily with the corn and Euchlaena pollen as with the plant's own pollen.

THE SECOND GENERATION

A few seeds representing each class of pollinations were planted in the greenhouse in December, 1913. From this planting there were secured seven plants, with the following parentage: Three plants from self-pollinated seed of the first generation cross; one plant from the first generation cross pollinated with Florida Euchlaena; two plants of the first generation cross pollinated with a Liberian variety of maize; one plant of the first generation cross pollinated with a variety of maize from Bolivia. The last plant was soon eliminated as the result of a peculiar abnormality. The sheath of the first leaf instead of being open on one side and enclosing

FEMALE PARENT OF THE CROSS

Plant of *Tripsacum dactyloides*, a grass which is fairly common in the southeastern United States. When crossed with the grass shown in the following photograph, it produced seeds, but did not seem to contribute any of its own characters to these seeds. Photograph made at Lanham, Maryland. Fig. 25

the succeeding internodes, was closed and solid, consequently the growth of the plant terminated with the first leaf.

During the early stages the remaining six plants all behaved much as did the first generation plant, the only observable difference being their more early branching and the fact that the branches were nearly prostrate for several months. Studies of Tripsacum seedlings disclosed no such tendency to produce horizontal branches from the lower nodes. Minor differences in the development and distribution of the hairs appeared, but these were not consistent even among the plants having the same male parents.

As the plants developed the diversity became more pronounced, although the variations were largely in the nature of abnormalities. With one exception the main axes of all the plants terminated their growth much earlier than is customary in Durango Euchlaena, only ten to fourteen internodes being produced. The branches from the lower nodes of all these plants greatly exceeded the main stalk in height and produced many more internodes. The exception noted was one of the plants having the Liberian maize for male parent. This plant produced 51 internodes, a larger number than has been recorded in Euchlaena, Tripsacum or maize.

The terminal inflorescence of these six second generation plants varied greatly, but none of the forms showed any approach to Tripsacum. One of the most striking abnormalities consisted in the replacement of the lower spikelets of the terminal inflorescence by little plants.[3] This abnormality occurred in the plant having the Florida Euchlaena for its male parent, in two of the second generation plants obtained by self-fertilization, and to a less extent in one of the plants having the Liberian maize for male parent. Several of these little plants which developed roots while still attached to the parent were removed and potted. They grew into plants resembling the larger branches or suckers of the parent plants and matured seed. Plants from some of the seed thus produced were grown during the past season (1915) and behaved like plants from self-pollinated seed of the second generation plants.

The diversities of the first lot of second generation plants, together with the occurrence of hitherto unobserved abnormalities, led us at that time to believe that although we could detect no indication of Tripsacum characters, the plants were something other than pure Euchlaena.

Further plantings from the original lots of seed secured from the first generation plant were made in the greenhouse in April, 1914. As soon as the weather permitted these were transplanted to the open and still other plantings were made directly in the open soil. We thus had second generation plants maturing in the greenhouse and others in the early stages growing in the open at the same time.

These later plantings, including both those transplanted and those planted in the open, developed none of the abnormalities observed in the first lot grown in the greenhouse. The straight second generation plants appeared to be pure Durango Euchlaena. The others were what might have been expected in first generation hybrids between Durango Euchlaena and the different types of maize used as male parents.

THIRD GENERATION

In the season of 1915 experiments were conducted near San Diego, Cal. The long growing season of Southern California afforded the first opportunity to allow plants of the hybrid to grow to maturity undisturbed. Small plantings were made of such second generation seed as had been obtained and the following plants were secured: ten plants from self-pollinated seed of three second generation plants of the hybrid; seventeen plants from self-pollinated seed of three plants of (Tripsacum x Euchlaena) X Liberian maize; five plants from self-pollinated seed of one plant of (Tripsacum x Euchlaena) X Florida Euchlaena. Plantings of Durango

[3] A similar abnormality has been observed in maize. See Collins, G. N., Apogamy in the Maize Plant. Cont. U. S. Nat. Herb., XII, Pt. 10, pp. 453-455, 1909.

MALE PARENT OF THE CROSS

Plant of Euchlaena, a grass which is grown to some extent for forage in the United States, under the name of teosinte. The variety here represented is that from Durango, Mexico; photographed at San Diego, Cal. In a cross with the grass shown in the preceding photograph, this Euchlaena proved so prepotent that the offspring cannot be distinguished from the male parent; while the female parent seems to have exerted no influence whatever on the heredity. This unusual type of heredity has been given the name of patrogenesis. (Fig. 3.)

THE HYBRID RESEMBLES THE MALE PARENT

Compare this plant with the one shown in the preceding illustration, and you will see no real difference. Yet this is a hybrid, in the first generation from the Tripsacum x Euchlaena cross. The identity between the male parent and the offspring is so close that the female parent seems to have done nothing but furnish nourishment for the development of the seed. (Fig. 4.)

FLOWERS OF THE TRIPSACUM

The hairy threads in the lower part of the picture are the pistillate or female flowers, while above are the male or staminate flowers, their dark-colored anthers or pollen sacs hanging on very fine filaments. Photograph natural size. (Fig. 5.)

Euchlaena were also made for comparison. The seed was planted on March 16, and a second planting of Durango Euchlaena was made on June 11. The third generation plants of the cross, with the exception of those that had been crossed with maize, all developed as normal Durango Euchlaena, free from any of the abnormalities observed in the second generation plants grown in the greenhouse. Early in the season the branches showed the prostrate habit characteristic of the first and second generation plants, but the Durango Euchlaena plants also showed the same habit. Curiously enough, the first planting of Durango Euchlaena developed a series of abnormalities almost exactly paralleling those of the second generation hybrid plants grown in the greenhouse. Of eighteen Durango Euchlaena plants, twelve produced aborted main stalks that matured with nine to thirteen leaves. Four of the eighteen plants produced apogamous plants in the place of spikelets. All of the abnormal plants produced numerous suckers that grew normally and were indistinguishable from the main stalks of normal Durango Euchlaena plants. The later planting of Durango Euchlaena was entirely free from these abnormalities.

Table 1 gives the average measurements of plants grown at San Diego. It can be seen that there are no striking differences between the hybrid plants and the Durango Euchlaena, the hybrid plants being in many particulars intermediate between the two plantings of Euchlaena. Where significant differences occur they are not of a nature to suggest Tripsacum.

Several hundred plants from open pollinated seed of the different second generation hybrid plants were also grown and carefully examined for indications of Tripsacum, but no characters or abnormalities not attributable to Euchlaena or maize were observed.

TRIPSACUM POLLINATED BY MAIZE.

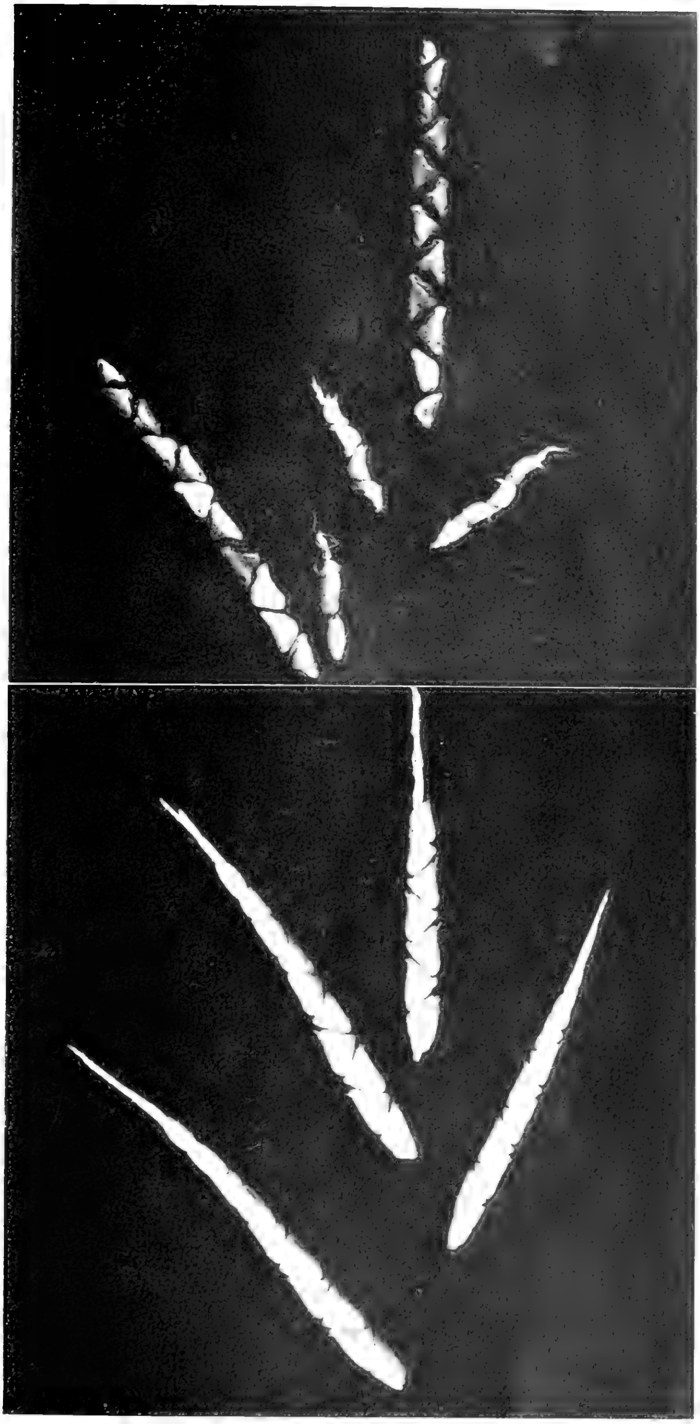
To repeat the original cross in the late plantings has been impossible, through a failure to bring Euchlaena and Tripsacum into flower at the same time. In 1914, however, maize pollen of several varieties was available at the time the Tripsacum plants were in flower. Numerous attempts to fertilize Tripsacum flowers with maize pollen resulted in a small quantity of viable seed. A number of plants from these seeds have been grown, but instead of resembling the male parent, all are apparently pure Tripsacum. These crosses were made with such precautions against accidental pollinations and have been secured in such numbers that there can be little doubt regarding the parentage of the plants. Euchlaena and maize are so nearly related and have behaved so much alike in the perjugate generations of our original cross with Tripsacum that we fully expect to secure similar results

TABLE 1.—COMPARISON OF TWO PLANTINGS OF DURANGO EUCHLAENA WITH TRIPSACUM X DURANGO EUCHLAENA, GROWN AT CHULA VISTA, CAL., 1915

	Durango Euchlaena planted March 16	*Durango Euchlaena planted June* 11	*Tripsacum X Euchlaena third generation*
Height in centimeters	313.0 ± 8.25	202.0 ± 5.51	200.0 ± 8.15
Exsertion of tassel in centimeters	6.6 ± .94	3.0 ± .48	1.7 ± .59
Branching space in centimeters	7.9 ± .45	11.1 ± .52	10.1 ± .31
Length of central spike in centimeters	13.8 ± .84	10.6 ± .44	8.2 ± .23
Length of lowest tassel branch in centimeters	17.5 ± .64	15.8 ± .72	11.0 ± .56
No. branches	10.1 ± .37	13.8 ± .64	12.3 ± .42
No. secondaries	16.0 ± 1.71	29.2 ± .36	27.2 ± 1.35
Length of longest leaf in centimeters	80.3 ± 2.01	67.8 ± 1.47	67.7 ± .87
Width of longest leaf in centimeters	4.2 ± .13	6.0 ± .20	4.0 ± .08
Nodes above longest leaf	9.6 ± .19	8.8 ± .39	10.3 ± .66
No. suckers	18.8 ± 1.48	8.1 ± .76	11.0 ± .95
Height of tallest sucker in centimeters	300.0 ± 10.10	195.0 ± 2.79	199.0 ± 10.90
No. exserted internodes	6.9 ± .26	7.7 ± .39	4.7 ± .37
Diameter of stalk in centimeters	2.2 ± .57	2.8 ± 1.27	3.2 ± .59

THE MALE PARENT AND THE HYBRID: FLOWERS

At the left are pistillate flowers of the Durango Euchlaena, while on the right are shown pistillate flowers of the cross between Euchlaena and Tripsacum. They are alike in almost every particular, and the flowers of the hybrid shown no influence of the parent—compare with fig. 5. Photographs natural size. (Fig. 6.)



THE MALE PARENT AND THE HYBRID: FRUITS

Below are fruits of the Durango Euchlaena, nearly mature, and shown natural size. The spikes are arranged as they were borne on the branch. Above are the mature fruits of the Euchlaena × Tripsacum hybrid, likewise arranged as they were borne on the branch, and photographed natural size. The fruits of the male parent and hybrid offspring are similar in every respect. (Fig. 7.)

MALE FLOWERS OF THE EUCHLAENA

They are much like the familiar "tassels" of maize, to which the Euchlaena is closely related. But they are also so much like the staminate flowers of the Euchlaena x Tripsacum hybrid, shown in the next photograph, that no one could tell the difference. Photograph natural size. (Fig. 8.)

MALE FLOWERS OF THE HYBRID

There is nothing in this inflorescence which resembles the flowers of the mother (Tripsacum), shown in Fig. 5. But every detail resembles the corresponding detail of the male flowers of the paternal parent (Euchlaena), shown in the preceding illustration (Fig. 8). This similarity with the male parent, and exclusion of all the characteristics of the female parent, appear in all the traits of the hybrids, and have led to the belief that we are here dealing with a new type of inheritance, which has received the name of patrogenesis. Photograph natural size. (Fig. 9.)

with Euchlaena pollen. It appears, therefore, that the complete resemblance to the male parent, which we secured in the first cross, was exceptional. Crosses between Tripsacum and Zea, at least, usually show a complete resemblance to the female parent. It seems not improbable that the maize pollen served only to induce parthenogenesis in the Tripsacum parent. With the view of determining this point material for cytological study has been secured and is being investigated.

CONCLUSIONS

A cross between *Tripsacum dactyloides*, female, and *Euchlaena mexicana*, male, has been carried through three generations without exhibiting any indication of the characters of the female parent. In attempting to explain this complete absence of the characters of the female parent two alternatives may be considered. (1) The characters of the female parent have been completely masked by those of the male, or (2) the male nucleus developed in the ovary to the complete exclusion of the female, representing in a way the counterpart of parthenogenesis. In the three generations of the progeny of this hybrid at least 350 plants have been examined. This and the fact that a great variety of conditions has called forth great variation and induced many abnormalities without evoking any indication of Tripsacum characters has caused the first alternative to be dismissed. If the second alternative be adopted we are compelled to look upon the results of this cross as a special type of inheritance not previously recognized. Hybrids showing a predominance of the characters of the male parent have been described as patroclinous, but in this cross and its successive progenies no trace of the characters of the female parent has been detected. No true hybridization or conjugation between the two nuclei appears to have taken place. For this form of false hybridization the name patrogenesis is proposed. The term patrogenesis would also serve to place the phenomenon in proper contrast with parthenogenesis. This is rendered appropriate by the occurrence of what appears to be true parthenogenesis in Tripsacum, when pollinated with maize.

The Effect of War

War and the Breed, by David Starr Jordan. Pp. 265, price $1.35 net. Boston, The Beacon Press, 25 Beacon Street, 1915.

Twenty years ago the idea that war was an important factor in changing the inborn nature of the human race was a novel one recognized by few. Dr. Jordan is largely responsible for making this fact seem almost a truism at the present day. In the present book he has explained the thesis with a great wealth of illustration, and in a most readable way, prefacing the main discussion with a short and popular outline of the various methods in which evolution proceeds. The volume therefore makes an interesting elementary treatise on eugenics, and one that from its timeliness ought to have a wide circle of readers.

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FEWER BIRTHS AND DEATHS: WHAT DO THEY MEAN?

Death Rate Falling in Civilized World in Recent Years—Birth Rate Falling Still More Rapidly—Death Rate Cannot Fall Much Farther, but Readjustment of Birth Rate along Eugenic Lines Is Necessary[1]

WALTER F. WILLCOX

Professor of Economics and Statistics, Cornell University.

CERTAIN important changes in death rates are revealed by a diagram showing annual death rates for a populous area through a long series of years. The American districts best satisfying these two conditions are Massachusetts, for which the death rate since 1849 is known, and the old New York City, for which the death rates run back now through more than a century.

The accompanying diagram shows the death rate in each of these areas for each year from the beginning of registration to the present date. (See fig. 10.)

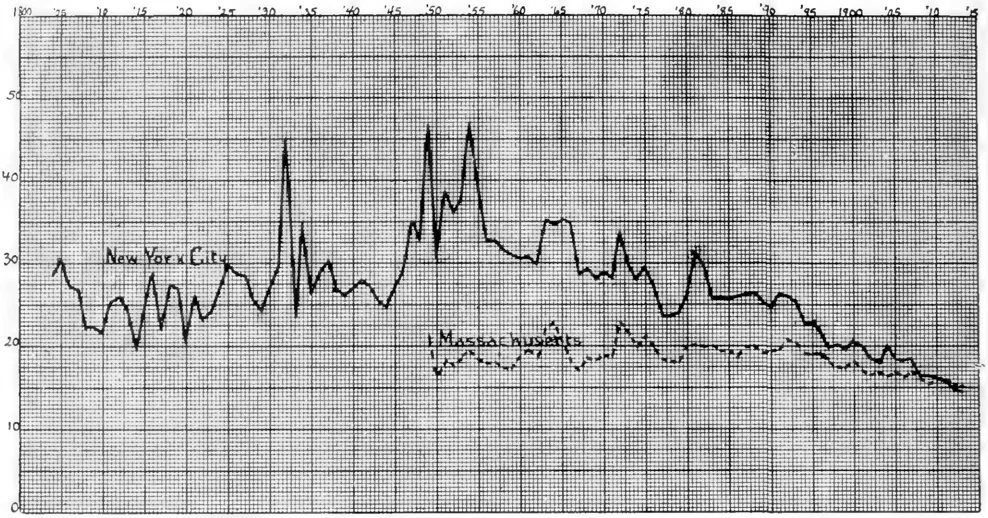
This diagram illustrates what a larger body of evidence would confirm, that the perceptible and steady decline in the death rate is a relatively recent phenomenon. In order to test the correctness of this inference, the average death rate has been computed for each decade and the ratio found between that rate and the rate in the preceding ten years taken as 100. The results are as follows:

These figures show that the decennial death rate in New York City rose for the forty years following 1810–19, but has been falling since the Civil War and is now much lower than ever before. In Massachusetts the rate rose until about 1880 and has been falling since that date, but at a slower rate than in New York. Decennial rates for at least two decades have been obtained in twenty-seven European countries and in every one the rate for 1901–10 was lower than for any previous decade. This evidence shows that the decrease of the rate is well-nigh universal in Europe. A few exceptions to the rule, however, are found in other parts of the world; namely, Ontario, Canada, Connecticut, Michigan, Vermont, Chile, Jamaica, Japan and Ceylon. But in some of these the rates at earlier decades were incredibly low and the apparent increase was probably due to more complete returns of deaths in the later years.

The diagram also suggests that the annual fluctuations began to decrease at about the same time that the rates

	Death rate in		*Ratio of rate to that in preceding decade = 100*	
Date	*New York City*	*Massachusetts*	*New York City*	*Massachusetts*
1804–09	26.3	....	....	....
1810–19	24.7	....	94.2	...
1820–29	25.8	....	104.2	...
1830–39	29.8	....	115.7	...
1840–49	30.3	....	101.5	...
1850–59	35.6	18.0	117.7	....
1860–69	31.7	19.4	89.0	107.8
1870–79	27.6	19.7	87.2	101.6
1880–89	26.8	19.6	97.1	99.6
1890–99	23.1	19.1	86.0	97.1
1900–09	19.0	16.0	82.3	84.0
1910–13	15.3	15.5	80.6	96.7

[1]Paper read by request before Section VIII, Public Health and Medical Science, Second Pan-American Scientific Congress, Washington. D. C.



THE DEATH RATE IS GRADUALLY FALLING

The solid line in this chart represents the death rate in New York City for more than a century, and shows that in spite of annual fluctuations the number of deaths per thousand of the population has been decreasing ever since the middle of the last century. For the last quarter of a century or more there is an almost uninterrupted decline, coincident with the increased attention paid to sanitation and public health. The dotted line shows the death rate for Massachusetts, which also decreased during the last quarter of a century. It is obvious that this decline in death rates can not proceed very much longer. Modern hygiene may postpone the death of a man, but it can not keep him alive forever. (Fig. 10.)

began to fall. To judge whether this is a general or only a local change, conditions in the twenty-three countries of Europe[2] for which the rates as far back as 1870 are known have been examined. The average annual variation has been determined. Naturally the successive years between which the greatest variation occurred were the years of transition from peace to war or *vice versa*. Thus, the greatest changes occurred between 1871 and 1872 and between 1870 and 1871. The war of 1876 exerted a less noteworthy influence. On the whole, the annual fluctuations have decreased but the change is less obvious and uninterrupted than students of individual cities or countries might expect.

Both the steady decrease in the death rate and the slow reduction in the annual fluctuations mark and measure man's progressive emancipation from physical ills of disease or famine, which are closely dependent upon climate and season, and, we might have thought, before August, 1914, from the political ills of war and revolution.

In New York State between 1894 and 1909 there was a marked decrease in mortality during July and August as compared with the average for the entire year. I believe no similar studies have been made for other States. In default of other evidence we may conclude that one factor in the diminishing death rate has been an increased control of deaths in summer. If this should prove to be a general fact, it would probably be connected with the success of efforts to reduce infant mortality. The hot months are especially dangerous to infants, while the cold months are especially dangerous to the aged.

Age influences the death rate more powerfully than any other physiological factor. Most people know that the death rate is lowest at the age of puberty and very much higher at the beginning and end of life. But the amount of

[2] For this purpose the three divisions of Great Britain and Ireland and the eight divisions of the German Empire have been distinguished.

difference is not commonly realized. In New York State boy babies under 1 year of age suffer from a death rate sixty-five times that of boys of 10 to 14. The death rate of nonagenarians rises to 159 times that of the youth.

It would be a natural expectation of one who is told that the death rate is rapidly falling that the gains had been distributed somewhat evenly up and down the scale of years. But this anticipation is not borne out by the facts. Even in a hurried survey like this two points, the possible increase of infant mortality and the possible increase of mortality among the aged, call for mention.

DEATH AMONG INFANTS

High medical authority in England alleged nearly ten years ago that infant mortality is stationary or increasing and this conclusion won some acceptance in the United States. Fortunately the figures proved to be susceptible of another explanation. But into that question there is now no need to go, since even in England and on the face of the figures infant mortality has decreased since 1900. Indeed among the nineteen countries of Europe for which statistics are at hand there is not one in which infant mortality has shown no decrease since the beginning of the twentieth century. In the United States the registration of births is still very defective and there are no large population groups for which we know the true infant mortality, that is, the number of children dying in the first year of life to each thousand living births. Our best substitute for this figure is the ratio between the deaths under 1 year of age and the living children under 1. In the registration States of 1900, comprising 26.3% of the country's population, this ratio fell from 162.4 in 1900 to 141.7 in 1910, indicating that infant mortality fell about one eighth in the decade.

When we turn to the other end of life, the indications of our American figures are less gratifying. In the registration States of 1900 the death rate decreased between 1900 and 1910 for every age period below 55 and increased at nearly every age period above 55. On this point our experience is apparently at variance with that of Europe. The latter indicates that before 1900 the fall in the death rate extended to all ages below 55 and was especially great at ages between 5 and 35, but that for ages above 55 it was slight or absent.[3] The English life tables recently published and speaking for a more recent period show that at every age above 5 years the mortality in 1901-10 was less than that in 1891-1900 and that the mortality in 1910-12 was less than that in 1901-10.[4]

DEATH AMONG THE AGED

The apparent increase of mortality at high ages in our registration States, in opposition to the general trend in other countries, invites and should obtain more careful and thorough analysis than it has thus far received or than I have been able to give it for this paper. Although it appears in both sexes, it does not show itself among women until the age of 60 is reached, while among men over 45 the death rate in 1910 exceeded that in 1900. It appears also among the three classes of native white, foreign born white and colored, earliest among the colored with whom the increase appears in each sex at every age above 30, latest among the foreign born whites with whom the increase does not appear in either sex until the age of 60 and then for females appears only for the ten year age period 60-69. It appears in a prevailingly agricultural State like Vermont at an earlier age and more definitely than it does in a prevailingly industrial State like Massachusetts or Rhode Island. In a recent reference to this change, based mainly upon the figures for Massachusetts and New Jersey between 1880 and 1910, three possible causes were mentioned, "the amalgamation of the various races that constitute our population," "lack of adaptation to our rapidly developing civilization" and "some unknown biologic influence," and a preference for the

[3] March, *Statistique intern. du Mouvement de la Population*, Vol. I, p. 450.
[4] Reg Gen., *Supplement to 75th Ann. Rep.*, Pt. I, Life Tables, p. 20.

second was indicated.[5] Thus far no evidence has been produced, I believe, showing that the increase is greatest where amalgamation of races is probably affecting the largest proportion of the population or where the lack of adaptation to a developing civilization is greatest.

An influence upon mortality which the United States is in a more favorable position to investigate is that of *race*. Under this term I do not include those residents in the United States who or whose progenitors were born in a certain country or spoke a certain language, like the Scandinavians or the French Canadians. At some future time we may be able to investigate the death rate of groups like those, although the present position and sluggish development of American vital statistics make one fear that the facts may become inaccessible before the country is ready to study them. I refer here to the two great races of white and colored, which include between them more than 99% of our population. The registration States of 1900 contained in that year 19,544,821 whites and 388,198 Negroes and many more in 1910, groups large enough and coming from States widely enough scattered to make the changes in their death rates between 1900 and 1910 somewhat representative of the changes in the whole country.

DEATH AMONG NEGROES

The death rate of whites in these States fell from 17.0 in 1900 to 15.5 in 1910, a decrease of 1.5 per thousand, or 8.8% of the initial rate. Meantime the death rate of Negroes in the same States fell from 25.6 in 1900 to 25.0 in 1910, a decrease of 0.6 per thousand, or 2.4%. These figures show that the fall in the death rate during the decade was more than twice as great among whites as among Negroes. Stating the same change in another way, the death rate among Negroes in these States exceeded that among whites by 51% in 1900 and 61% in 1910.

But to compare the two races in this way and stop without noting whether significant differences exist between the age and sex composition of the two groups might easily lead us into error. Thus among the whites 50.5%, but among the Negroes only 48.3% were male. As the female death rate is lower than the male the true difference between the death rate of the races would probably be greater than the foregoing figures indicate. Even more important is the fact that of the whites 21.5%, but of the Negroes only 16.1% are either children under 5 or aged (55+) and have the high death rate characteristic of infancy and old age.

Probably the best way to measure the effect of these differences in sex and age composition is to compute standardized death rates for each race. When the death rates of each race for a given sex and age are applied to the population of the same sex and age in a standard million distributed as in the registration States of 1900, the standardized death rate in 1910 is found to be 15.5 for whites and 27.5 instead of 25.0 for Negroes, showing that the corrected death rate of Negroes exceeds that of whites by 12.0 per 1,000, or 78%, instead of 9.5 per 1,000, the difference of the crude rates. The corresponding standardized death rates in 1900 were 16.9 for whites instead of 17.0 and 29.0 for Negroes instead of 25.6, showing a fall during the decade of 1.4 per 1,000 for whites and 1.5 per 1,000 for Negroes. But in 1900 the standardized Negro death rate exceeded that of the whites by 72% as compared with 78% in 1910. The standardized death rate among female Negroes exceeds that among female whites by 61% in 1900 and by 72% in 1910, while the difference among males was 69% in 1900 and 84% in 1910, showing that the difference between the males of the two races is greater and increasing more rapidly than among the females. The death rate of each race is falling, but the gap separating the two races has seemingly grown wider. Before the Civil War, according to what evidence we have, the death rate of Negroes exceeded that of whites by 29.8% of the lower rate, and

[5] Fisher and Fisk, *How to Live*, p. 282. See also Lewinski-Corwin in *New York Times, Magazine Supplement*, December 19, 1915.

in 1890 the difference was 56.5%. These earlier rates are not strictly comparable with each other or with those for 1900 and 1910, partly because they speak for different areas, neither of which agrees with the registration States of 1900, and partly because in them no attempt has been made to allow for differences in the age and sex composition of the two races or for changes in these respects. The general conclusions, however, that the death rate of each race has fallen by approximately the same amount and that the ratio by which the Negro rate exceeds the white has been rising, seem to be supported by evidence enough to make them deserve acceptance.

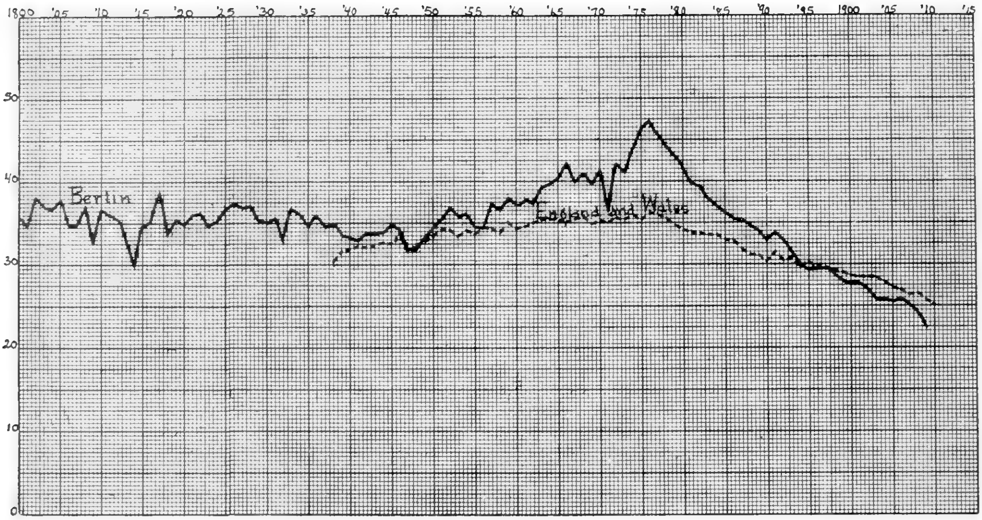
MARRIAGE AND LONG LIFE

Still another influence upon mortality which has been recently investigated is that of *marital condition*. European figures indicated long ago that the mortality of husbands is much less than that of bachelors or widowers of the same age and the conclusion is now corroborated by figures for New York State. No doubt this difference is largely due to the selective process by which the men who marry are, on the average, at the time of marriage more healthy and vigorous than men of the same age who do not marry. Evidence that direct benefits to health accrue from married life is found in the death rate of widowers, which is much higher than that of husbands; in the death rate of Catholic celibate clergy, which is higher than that of Protestant clergy, most of whom are married; and in the death rate of all males during the years at which marriage is most common. The normal and usual course of mortality in each sex is for a slow but steady increase to begin just after the minimum is reached in the early teens, and to continue with accelerating rapidity to the end of life. To this course there is no significant exception among women, but among men in several countries the increase is checked or even turned into a slight decrease for a longer or shorter period between the ages of 20 and 35 when marriage is most common. The probable explanation is that the normal increase of mortality during these years is nearly or quite neutralized by the steady transfer of many men from the less healthy bachelor state to the more healthy married state. The explanation finds some support in the fact that during these years the death rate of bachelors and of husbands treated separately rises steadily with age. On the whole, the evidence justifies the inference that marriage exerts a directly beneficial influence on men's health and prospects of longevity. For wives the facts are less favorable. In New York the death rate of wives between 20 and 29 is greater than that of single women at the same age period. The difference is slight and part of it no doubt is due to the fact that wives 20 to 29 years of age are, on the average, more than two years older than spinsters belonging to the same age group. But as less than half the difference can be thus explained, it seems clear that in New York, as in most other areas in which the facts have been determined, during the early years of married life wives have a higher death rate than spinsters and probably that the difference is largely due to the dangers attending childbirth, especially among those bearing a first child.

THE BIRTH RATES

There are no American birth rates which extend over a long series of years and may be trusted as accurate. In default of evidence from this country I have used in the diagram the birth rates for England and Wales since 1838 and for Berlin since the beginning of the last century. (See Fig. 11.)

The diagram shows that the birth rate was probably at its maximum about 1875 and has decreased almost steadily since that date, that the decrease in England has been about one-third and in Berlin about one-half of the maximum amount, that the variations both from year to year and through longer periods were greater in the city than in the entire state, that the decrease since 1876 has been almost uninterrupted, that there was a marked depression in both areas in 1890, and that Berlin had a much more notable depression in 1871. If in



THE FALLING BIRTH RATE IN BERLIN AND ENGLAND

Formerly the fluctuations in the annual birth rate seemed to depend on natural conditions, but for the last generation there has been a steady fall which is generally ascribed to artificial conditions. Although its causes are many, the principal one is believed to be that married people are gradually learning how to avoid having children. Up to a certain point, this decline in the birth rate was a natural result of the decline in the death rate. Otherwise population would probably have increased faster than wealth. But if it goes any farther, the results to the race may be serious. (Fig. 11.)

the earlier diagram we had used the death rates for Berlin, high points on that curve would have been revealed in 1871 and 1890 when the birth rates were low.

As a rule influences which tend to increase deaths tend also to decrease births, and influences which tend to decrease deaths tend to increase births. This appears even in the rhythm of each day, Italian figures apparently showing that deaths are most frequent and births least frequent in the afternoon. There is also a yearly as well as a daily rhythm traceable in the figures but in this case the reciprocal relationship is between conception as mirrored in the births nine months later and deaths. There is some evidence that during the late spring and early summer and again during the late fall the death rate is low and the conception rate high. There is some evidence, likewise, that during the late winter and the late summer the death rate is high and the conception rate low. This reciprocal relationship between births or conceptions and deaths appears also in the case of any great social calamity. As a war or a pestilence raises the death rate, so likewise it depresses the birth rate, and in estimating the social effect of either it is of the first importance to consider not only the deaths it has caused but also the births it has prevented. For example, in Massachusetts between 1860 and 1864 the death rate rose from 18.7 to 22.8, an increase of 4.1 per 1,000, and the birth rate fell from 29.3 to 24.2, a decrease of 5.1 per 1,000. In Sweden continuous and trustworthy records of births and deaths have been maintained without a break since 1749, a longer period than in any other country. The year 1773 was marked by the heaviest death rate of this century and two-thirds and during that year the birth rate was also lower than in any year before or since. The most universal and fatal epidemic which has afflicted civilized countries of recent years was probably the first of the recent visitations of influenza, which spread over Europe and America in the winter of 1889–90 and caused in New York State about 5,000 deaths. Wherever the births were reported and published by months one finds, nine

months after the influenza epidemic was at its height, a marked shortage of births. There were at least 200,000 fewer births in Europe in 1890 than the average annual number for the preceding five year period.

THE CHANGE OF TENDENCIES

Now the most marked change in the birth rate during the last half century, a change revealed by a comparison between the two diagrams, has been the gradual decline and almost complete disappearance of this reciprocal relationship between births and deaths and the appearance in its place of a tendency for births and deaths to change in the same way rather than in opposite ways. Before proceeding to consider the causes, let me set forth the facts a little more fully.

1. The birth rate and death rate now remain approximately the same in any given country during any few years. The sharp annual variations which characterized these rates and which are still traceable in the statistics of undeveloped countries are disappearing.

2. The tendency of both death rates and birth rates is to undergo large and important modifications in longer periods of time. The sharp up or down movements in both curves connected with such causes as war, pestilence or famine on the one hand, or bountiful harvests and cheap food on the other, are being succeeded by a steady progressive downward movement in the death rate and the birth rate.

Regarding the birth rate in the United States we know practically nothing. But in default of this information I have found an available substitute by comparing the number of children under five years of age at the date of each census with the number of women 16–44 years of age at the same census. The results are given in the following table, in which the figures before 1850 are estimated from such data regarding sex and age as the earlier censuses afford.

Date	*Children under 5 years of age to women 16–44*[6] *years of age*
1800	976
1810	976
1820	928
1830	877
1840	835
1850	699
1860	714
1870	649
1880	635
1890	554
1900	541
1910	508

During the sixty years 1850–1910 the proportion of children to 1,000 women of child-bearing age decreased in the United States by 191, or an average of thirty-two in each decade. There are only about seven-tenths as large a proportion of children in the United States now as there were in 1850. If we assume that the change will continue in the direction in which it has been moving ever since 1860 and at this average rate of thirty-two in a decade, the number of children under 5 in the country to each 1,000 women 16–44 will be as follows:

1920	476
1930	444
1940	412
1950	380
2000	220
2050	60
2060	28
2070	0

The figures indicate that, if changes like those which have been in progress in the United States since 1850 were to continue unchecked for a century and a half there would be no children left. Let me not be understood as predicting a continuance of the movement for any long period in the future. But often the best method of bringing home to ourselves the vast sweep and significance of the changes revealed by statistics is to project them into the future and see whither they lead. No doubt social movements do not occur along straight lines. On the contrary sharp inflections in the curves of social change are frequent. But it is one of the main duties of statistics to point out the trend of the stream along which society is moving and thus perhaps to arouse a desire for a change.

This tendency to a decline in the

[6] In order to reduce estimates to a minimum in the earlier decades ages 16–44 were chosen instead of 15–49, the more usual limits.

birth rate is in nowise confined to the United States. On the contrary the movement in most European countries has been in the same direction. In twenty-four European countries, all, except Ireland, Portugal and Bulgaria, for which the records are at hand, the birth rate 1901–10 was lower than in the preceding decade and in nearly all of them it was lower than in any earlier decade.

In considering the *causes* of this great change, let me refer first to the position of Herbert Spencer. He has argued that the various organs of the body compete with each other for nourishment and growth, that the surplus not required by the individual is all that can be devoted to the continuance of the race, that no other system makes demands upon the body as heavy as those of the nervous system, that civilization and education are steadily increasing this drain and decreasing the surplus. He finds, therefore, a natural and inevitable connection of a physiological kind between an advancing civilization and a decreasing birth rate. Some students of American statistics have sought to find support for this position in our fragmentary and elusive material. I cannot go farther with the question this morning than to express my judgment that these efforts have not been successful and that there is no conclusive evidence, statistical or otherwise, in support of Spencer's contention. While admitting the heavy and increasing demands upon the nervous system made by modern conditions, I would point out that the decreased death rate and the decrease of sickness by which it is probably attended mean an increase of human vitality and so of the surplus to be drawn upon. Whether the increased expenditure on the nervous system equals or exceeds this increased surplus no one has even tried to prove. Until that is done I believe the Spencerian theory must be deemed only a theory.

THE "RACIAL POISONS"

Nor can we admit, as others have argued, that the decreased birth rate in civilized countries is due either to the growing abuse of alcohol or to the spread of venereal disease. Such arguments have come mainly from special students of these social evils and such students often lose the sense of proportion and find a relief from every social ill in the one reform on which their eyes are riveted.

Walker explained the decrease in the American birth rate by the menace to the American standard of life from the influx of swarms of immigrants accustomed to cheap food and clothing and bad housing and to the effect of this menace upon the birth rate primarily of the native stock and ultimately of the entire population. This explanation is improbable, because the decrease as we have seen began as early as 1810, when immigration was an unimportant influence, and has been matched in Australia, where it must be due to other causes than that assigned by Walker, since Australia has had no great influx of immigrants.

Turning from these inadequate explanations, the true reason for the fall in the birth rate is that in modern times, mainly within the last half century, births and the birth rate have come under the control of human will and choice in a sense and to a degree never before true. Our leading American authority, Dr. John Shaw Billings, put it as follows: "The most important factor in the change is the deliberate and voluntary avoidance or prevention of child-bearing on the part of a steadily increasing number of married people who prefer to have but few children." Before this change began the birth of a child was, to be sure, the result of normal physiological processes, but in the vast majority of cases the birth itself did not indicate a deliberate preference for that result on the part of both or either of the parents. There is not a single one among the experts who denies that this is the great underlying cause of the modern decline in the birth rate of all civilized countries.

FEWER BIRTHS NECESSARY

In considering this change may I first suggest that some such change was an almost necessary consequence

of the great decline in the death rate? That is, if the death rate in Europe had declined as rapidly as it has and the birth rate had not declined, the population of that continent would now be increasing even faster than the wealth or the food supply. The standard of living would be sinking and we would probably soon relapse into our former ill state. It is the decline in the birth rate, and that only, which has enabled mankind to grip and hold fast the advantages promised by the decline in the death rate.

But there is a very important difference between the two changes. It is probably to the interest of society in the long run that each individual should be given a chance to live out his life to old age, and social effort directed to that end is beneficial both to the individual and to society. Thus far the interests of the two coincide. For this reason the two have cooperated and are cooperating effectively to reduce the death rate. But in the matter of the birth rate there is a lack of adjustment between the interests of society and those of the individual. Society is deeply concerned that enough children should be born to secure its own permanence and a reasonable increase and that those children should have the highest promise of service. The individual is deeply concerned not to compromise his own future by assuming responsibility for wife or family without the prospect of being able to maintain them in accordance with his standard of living. The individual may often see for himself or herself, therefore, a balance of advantage in abstinence from or postponement of marriage, in a childless marriage or a small family, while society from its point of view might conceive it to be most important that a given endowment of much social worth should be perpetuated.

If there were time it would be easy to show that a low and diminishing birth rate is especially characteristic of many strains of population, like college graduates of both sexes and the native American stock of the New England States, strains perhaps better endowed than the average population with hereditary qualities the perpetuation of which is socially desirable.

SIGNIFICANCE OF EUGENICS

While persons engaged in grappling with public health problems should interest themselves in the various changes I have briefly outlined, the main question which my figures raise is this, How shall the desirable natural increase of the population be secured and at the same time the quality of the population be maintained or improved by securing at least a normal or average and, if possible, a more than normal birth rate and natural increase in the strains of population which are of the best stock and therefore likely to transmit qualities of greatest social worth?

In this difficult field a few general principles may be stated dogmatically, which I would be glad to explain and defend, if there were time.

1. The death rate cannot be expected to fall much below where it now stands in healthy districts.

2. There is no such natural limit to a fall in the birth rate.

3. The spread in the volitional control of the birth rate is a change against which, even if we believe it undesirable, it is hopeless to struggle.

4. Legal regulations of marriage in the effort to diminish the number of births of diseased or otherwise undesirable children seem likely, unless accompanied by segregation, to do more harm than good.

5. The social service rendered by parents who have hereditary qualities of great value and make heavy sacrifices in other directions in order to rear families of normal size or larger is likely in future to be much better appreciated and requited.

6. Persons interested in maintaining the numbers and improving the quality of the population should aim not merely or mainly at a continued reduction of the general death rate but also at the gradual education of public opinion towards a readjustment of the birth rate in various classes which will enable society to gain from its best strains more than it can do under present conditions.

WHAT THE SIZE OF AN EGG MEANS

Current Belief that Small and Large Eggs Are Produced at the Beginning or End of a Hen's Laying Period is Found to Be Wrong—Usually Appear When Hen is Laying Most Heavily and Steadily

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IT IS believed by some poultrymen and other observers that the very small and very large eggs which hens occasionally lay are the first or last eggs of the hen's laying period. Lewis[1] states that "the extremely small eggs laid by hens during their laying period are common at the beginning or end of the hens' laying period." The Journal of Heredity[2] in a review of some recent work on Xenia in Fowls shows a photograph from the Bureau of Animal Industy, U. S. Department of Agriculture, and states that "eggs of any individual hen tend to become a litt e smaller as she approaches the end of her laying period and the last one, it is generally believed, is likely to be a dwarf."

That this idea is wrong the writers have been able to demonstrate by a study of the abnormal eggs laid by the hens in the third and fourth egg laying contests held at the Connecticut Agricultural College, Storrs, Conn., for the year ending October 30, 1914, and up to June 1, 1915.

The number of eggs laid by the 1,820 hens during the 20 months' period was 199,137 of which 103 were small (less than .09 of a pound) and 89 were large (over .179 of a pound). The small and large eggs had been credited to the hens that laid them and the weights of the individual eggs also had been taken. The 103 small eggs were laid by only 85 hens, showing that only a small percentage of the hens laid a small egg during their first year of laying. Four hens out of the 85 laid two small eggs at different periods of their productivity. One hen, No. 900, laid fourteen small eggs at different periods and did not have a single normal egg to her credit when she was removed from the pen. This is an exceptional case and further studies are under way in order to determine the cause.

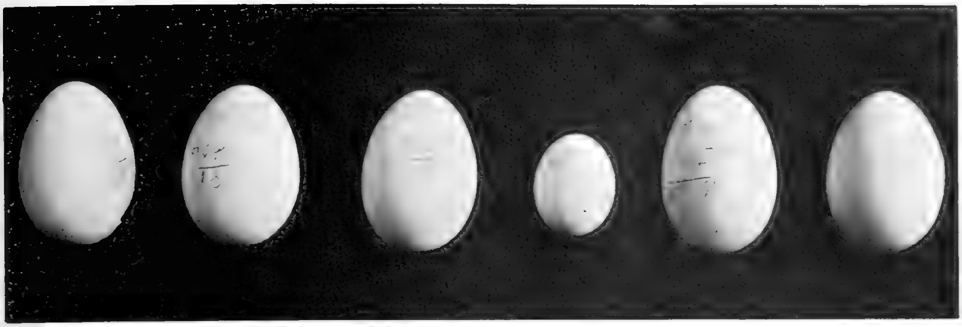
NO REST PERIOD

The first attack on the mass of figures was intended to determine whether a hen usually rested after laying a small egg. It was found that only two eggs out of a total of 103 indicate a resting period[3] after the production of a small egg. In every other case the small egg was found in an almost uninterrupted series of normal eggs. This seems to prove conclusively that small eggs may be laid at any time during a hen's laying period and that most small eggs are laid while hens are at the height of production. Out of the 103 small eggs, 42 show no resting period whatever; in 34 cases the hen rested on the following day, in 13 there was a resting period of 2 days, in 4 cases there was a pause of 3 days, 8 cases show an average period of 6¼ days, and only 2 cases, as noted above, showed a real resting period. But none of these interruptions of the laying is great enough to be considered a real resting period; none of them is greater than is often found with any normal hen during the period of her greatest

[1] Productive Poultry Husbandry, page 306.

[2] Journal of Heredity, Vol. 6, No. 5, May, 1915.

[3] Bulletin No. 82, Connecticut Agricultural College. "The average length of time that a hen rests after becoming broody is about 19.2 days."



A SMALL EGG APPEARS UNEXPECTEDLY

Eggs laid by one hen on six consecutive days are shown in this photograph. They are, with one exception, of average size. The abnormally small egg appears in this series without the slightest warning. The hen has not had any resting period before laying it, nor does she take a resting period afterward. The study of many cases of this sort shows that small eggs are not "pullets' eggs," or the last eggs laid by hens, as is often supposed, but that they usually appear at a time of greatest egg yield, and are probably due to some mechanical interruption in the hen's egg-forming organs. (Fig. 12.)

egg yield, the last two cases excepted, of course.

Having investigated the records of the hens *after* they laid small eggs, it seemed well to inquire what they were doing *before*. Seven records seem to indicate that some small eggs were laid after a hen had had a resting period of from 14 to 25 days. Most of the records show, however, that the small eggs are laid without any previous resting period of the hen.

The figures also showed that as a rule hens do not lay extremely small eggs at the beginning of their laying periods, but that such eggs are laid at a time when the hen is laying most heavily.

It seems clear, therefore, that the small egg is not due to the fact that it is a hen's first attempt, or to the fact that it is the end of her laying period, and represents exhausted power. A fairer assumption as to the cause of these small eggs would be that they are due to some mechanical interference with the hen's normal functions — that they are laid whenever a particle of blood, foreign element, or an undeveloped yolk is drawn into the passage where the shells are formed, and that contractions of the oviduct then cause an egg to be laid completely formed, but without having undergone normal development.

STUDY OF LARGE EGGS

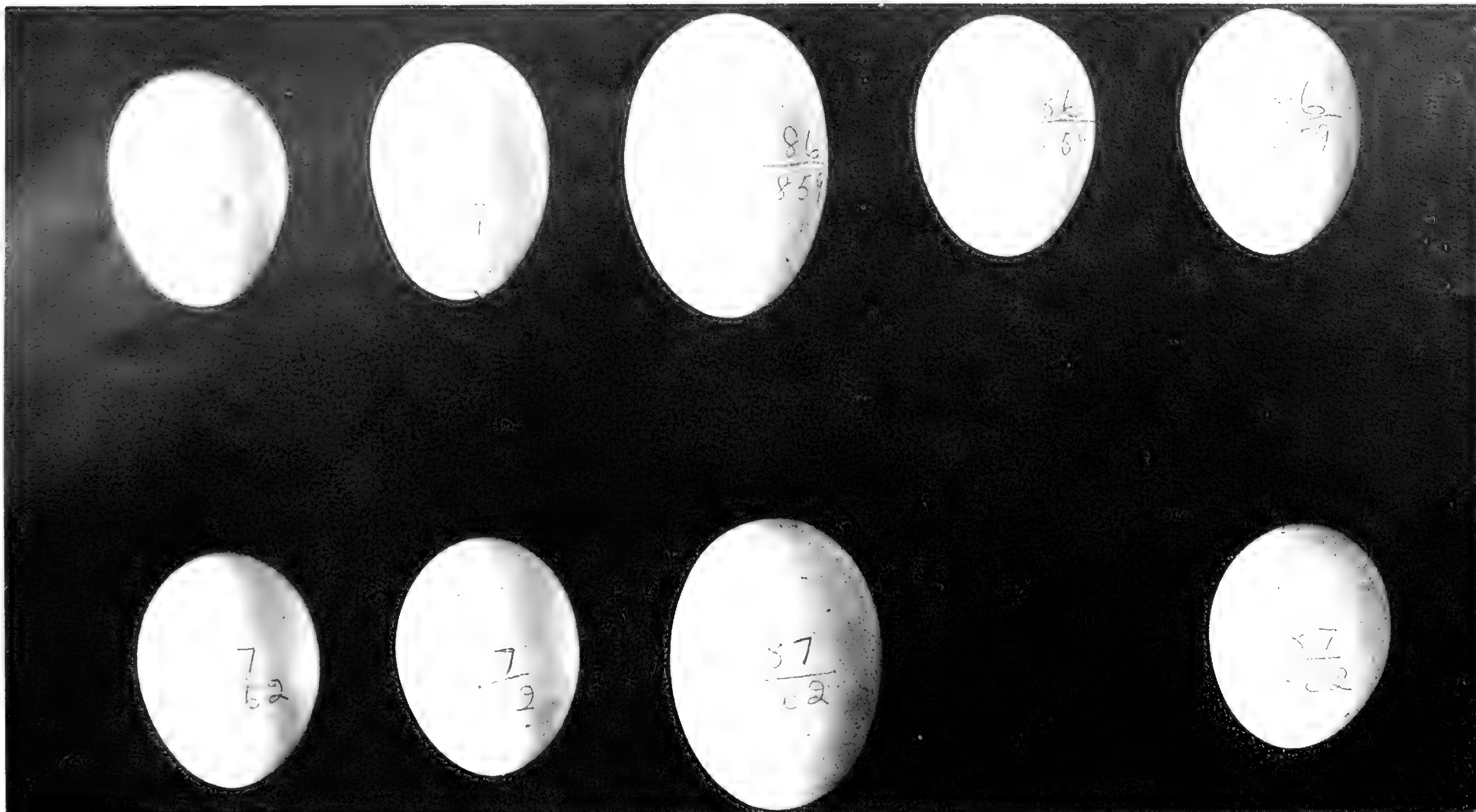
After consideration of the small eggs, the records of production of large eggs were then examined. Eighty-nine were found to have a total weight of 18.35 pounds or an average weight of .206 of a pound.

Of these eighty-nine large eggs, nearly 99 per cent were laid at the time of heavy production, and in most cases the hen did not rest after laying such an egg, but continued her uninterrupted yield of normal eggs.

"The cause of hens laying double-yolked eggs is due no doubt to the simultaneous or almost simultaneous liberation of two yolks and their incorporation in a single set of egg membranes,"[4] or "by the successive discharge of separate follicles at times varying from simultaneous to the normal period and by the subsequent union of the eggs in the duct due to a difference in the rate of passage of the successive eggs."[5]

It further appeared that in most cases the hen did not rest before laying a large egg any more than she did after

[4] Lillie's "Development of the Chick," page 26.
[5] *Journal of Agricultural Research*, Vol. 3, No. 5, February, 1915.



LARGE EGGS COME WITHOUT WARNING

This photograph represents six consecutive days in the egg-laying history of of two hens. They are both laying regularly, and laying eggs of normal size. In the first case (shown above) a large egg suddenly appeared, and then the normal laying was resumed, without the lapse of a single day In the second case (shown below) the large egg was followed by a rest of a single day; but such breaks in the series occur frequently, with every hen. It appears from the study of such cases as these that a large or double-yolked egg has no special significance in the life of a hen. (Fig. 13.)

such a performance. Forty-five of the large eggs were laid without any previous resting period, thirty-one were laid with a resting period of one day before, and ten were laid with a resting period of two days.

It seems obvious, therefore, that neither small nor large eggs are necessarily laid either at the beginning or end of a hen's laying period, but that they are most often laid during the time of heavy egg production.

TABLE I.—*Weight in Grams of Small Eggs and Weight of Eggs Immediately Preceding and Following.*

No. days.	1	2	3	4	5	6	7	8	9	10	11	12
1911–1912												
Hen No. 263	....	54.4	45.4	....	49.9	**13.6**	49.9	....	54.4	....	49.9	49.9
1912–1913												
Hen No. 126	68.0	....	68.0	63.5	....	**18.1**	....	68.0	63.5	....	63.5	63.5
1913–1914												
Hen No. 629	49.9	....	49.9	49.9	....	**13.6**	49.9	....	54.4	....	54.4	54.4
1914–1915												
Hen No. 806	48.2	48.6	....	47.5	47.5	**27.4**	48.0	48.4	48.6	....	....	48.2

TABLE II.—*Weight in Grams of Large Eggs and Weight of Eggs Immediately Preceding and Following.*

No. days.	1	2	3	4	5	6	7	8	9	10	11	12
1911–1912												
Hen No. 219	58.8	58.9	....	58.9	**86.2**	....	54.4	54.4	....	54.4	54.4	49.9
1912–1913												
Hen No. 144	58.9	....	58.0	....	**90.7**	....	63.5	58.9	58.9	....	58.9	58.9
1914–1915												
Hen No. 862	58.9	....	58.9	58.9	**90.7**	....	54.4	58.9	63.5	58.9	....	63.5
1914–1915												
Hen No. 321	....	70.1	50.4	....	**91.9**	56.4	56.9	56.9	....	50.4	50.1	....

Civilization and Climate

CIVILIZATION AND CLIMATE, by Ellsworth Huntington. Pp. xii + 333, price $2.50 net. Yale University Press, New Haven, Conn.

By experimental tests and an appeal to history, Professor Huntington supports the thesis that a particular kind of climate is necessary to the development of a high civilization and that man is, therefore, more dependent on his environment than he is wont to suppose. The conditions which seem essential to the writer are a fairly high average temperature with moderately large daily fluctuations. This peculiar type of climate prevails today wherever civilization is high, the author thinks; in the past the same type seems to have prevailed wherever a great civilization arose. Therefore such a climate seems to be a necessary condition of great and permanent progress, although by no means the only, or the most important condition—much less a cause. In supporting this thesis, the author is led to an extended discussion of the importance of race, in which he shows admirable poise. The book is unusual, as the presentation of a novel and valuable hypothesis, in a most interesting manner, and with an amount of well-balanced judgment which writers of books like this seldom show.

HEREDITARY NOSE BLEED

Tendency Runs Through Three Generations of a Family—Manifests Itself at Adolescence and Disappears after a Few Years—Possibly Connected with Sex[1]

WILLIS C. LANE
University of Maine, Orono, Maine

SOME years ago I knew two young people who had nose bleed nearly every day, and from no apparent external cause such as injury or exertion. Last spring a third case of this peculiar nose bleeding was found. It so happened that all three of these people were related; and I was told of other cases among their relatives. An inquiry was made and, with the aid of a relative, thirteen cases of this peculiarity were found, all of which are represented on the accompanying chart. Most of the members of this greater family (of which all names will be absolutely withheld) live in neighborhoods where I am acquainted; I know personally most of the individuals represented on the chart and all of those possessing the character in question.

Those individuals who possess the trait have frequent, copious and regular nose bleedings, not apparently arising from such causes as injuries, excitement, exertion, or like factors. These bleedings first manifest themselves, in either sex, at the period of adolescence, and continue until the individual is 18 or 20 years of age. In a few cases the bleeding occurs daily, in other individuals about three times a week. The loss of blood does not seem in any way to incapacitate the subject, save to stop work or play for a moment or two while the blood is flowing.

With but one exception all the individuals who showed this peculiarity were healthy, vigorous, well nourished and developed rapidly after puberty. Indeed, it appeared that those individuals who bled from the nose the most frequently and who lost the most blood showed the greatest activity and developed most rapidly.

Invariably in case the regular nose bleeding did not occur the subject would have headache and a general bodily and mental depression which would be relieved by nose bleeding. In other words, there was a general blood congestion with its accompanying symptoms, which symptoms disappeared after the blood pressure was reduced. In fact, nose bleeding was sometimes purposely induced to obtain relief when the regular bleeding did not occur.

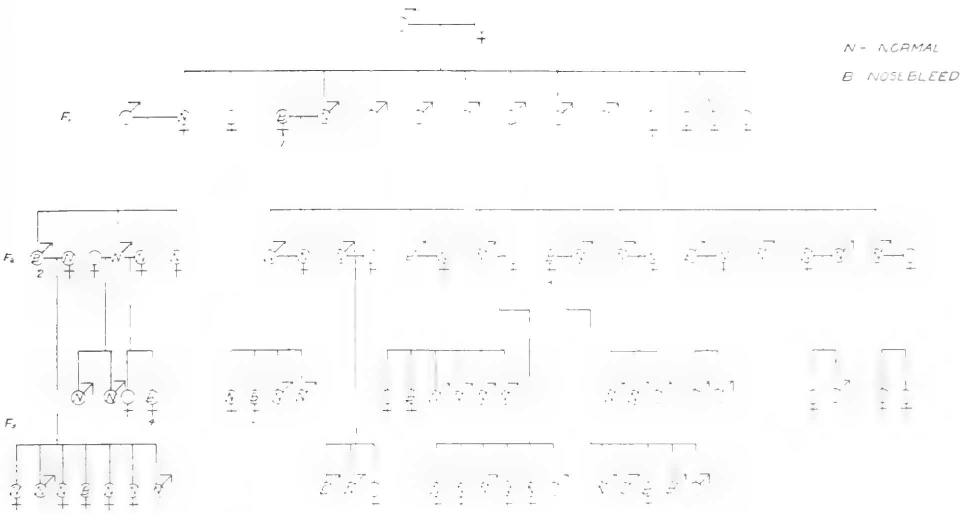
Individual No. 2 in the second generation exhibited the peculiarity most strongly. His nose would bleed profusely every day. This was especially marked in his sixteenth year, and yet at this time there was a remarkable body growth. He worked very hard, seeming never to tire, and was never sick. The nose bleeding diminished the next year and ceased entirely in his eighteenth year.

Individuals Nos. 1 and 5 on the chart are characterized by typical vicarious menstruation in addition to the peculiar nose bleeding. The latter occurred quite regularly about three times a week and ceased at about the eighteenth year.

Individual No. 4 in the third generation also showed this peculiar vicarious function at times.

Individual No. 3 had nose bleed more or less frequently up to her death which resulted from an uncontrollable nose bleed at the age of 45. None of the other cases exhibited anything unusual

[1] Dr. Raymond Pearl, to whom thanks are hereby given, has criticized this paper and made valuable suggestions.



HOW NOSE BLEED IS INHERITED

Nothing is known about the first generation here charted, but from then on it appears regularly in some of the members of each generation. (Fig. 14.)

except the regular nose bleeding that ceased at the age of 18 to 20.

Considering that this peculiarity first manifests itself at puberty, it perhaps bears a very close relation to the developing sex organs. It may be that the internal secretions of the gonads are being poured into the system and stimulating blood formation faster than the body can take care of it, and the excess blood leaves the body by breaking through the mucous membrane of the nose. The superabundance of blood would help to account for the rapid development and increased activity at this period. As the internal secretions and the body came to be adjusted to each other, we may suppose that the phenomenon diminished and finally disappeared (with the one exception).

Davenport[2] gives a few cases of diseases of the blood and with evidence that the tendencies are inherited. The peculiarity herein described is probably very similar or the same as one Davenport gives under the caption "Nose bleed (Epistaxis)."

This trait differs from hemophilia in that it occurs in both sexes, only for a few years, and then disappears; and to all appearances the blood coagulate normally.

Some people who suffer from catarrh have frequent but irregularly occurring nose bleed. This is usually due to the erosion of the mucous membrane and generally is induced by slight injuries, and is in no way correlated with sex development.

One frequently encounters people who have a hypersensitive nose, so that very slight injuries result in bleeding. This trait usually is apparent long before puberty; if proper precautions are taken bleeding does not occur; and the absence of bleeding is not followed by depression. In fact these cases are apt to be weakened by bleeding. Such bleeding seems to result from high pressure of blood on very thin and delicate membranes. It is altogether possible that individual No. 3 on the chart was of this type.

The accompanying chart well shows the distribution of the trait in question. The blank spaces in the first and second generations are those from whom no data have so far been obtained regarding the trait. The blank spaces in the third generation represent individuals

[2] Davenport, C. B. "Heredity in Relation to Eugenics," p. 153. New York, 1911.

who have not yet passed childhood. There are a number of children already in the fourth generation and it will be interesting to watch their development and those of the third generation to see whether new cases of nose bleed appear.

The maladjustment between blood formation and the body requirements may be inherited. At present all that can be said, from the data we have, is that it occurs in three generations of one family. Further search may reveal its appearance in more of the first generation or of their descendants, and time may prove its development in the fourth generation.

The Tendency to Multiple Births

One of the most extraordinary cases of human fecundity is that recalled by R. Berger in the Zentralblatt für Gynäkologie (**1914**, **10**) on the authority of the "Gessellschafter von 1834." The case is that of a man whose first wife had quadruplets four times, triplets three times and twins ten times; and whose second wife had triplets once and twins ten times. The man was, therefore, the father of sixty-eight children. Dr. Berger assumes, as both wives of the man were thus fecund, that the tendency to multiple births was due to the father rather than the mother; but the idea seems hardly tenable, for the production of several children at once is naturally due to the production of several ova at once, and it is hardly conceivable that the father has any influence in the production of ova. Yet as a recent study of the inheritance of twinning in sheep has likewise seemed to indicate a slight influence on the part of the sire, in the production of twins, the whole question deserves a careful examination.

Immigration after the War

European emigration to the United States is likely to increase after the war, according to Professor Robert De C. Ward of Harvard University, who writes in the *Eugenics Review* (London, January, 1916). At the same time, the physical and mental quality of the immigrants is likely to show a decrease over the standard which has prevailed in the past. A serious situation is therefore confronting eugenists. As measures which will aid in preventing the deterioration of the national stock, Dr. Ward suggests a heavier fine for steamship companies which attempt to bring mentally defective aliens to the United States, more thorough examination of immigrants at port of entry, extension from three to five years of the time in which an immigrant may be deported if he becomes insane, and an extension of the list of classes of immigrants who are excluded altogether. But more effective than any single measure, Dr. Ward thinks, would be a measure which would restrict immigration in general. He favors some such provision as the *reading test* embodied in the Immigration Bill which was vetoed last year by President Wilson.

TRIPLET CALVES

Some Families of Cattle Produce Many of Them, Others None—Heredity Involved But Its Working Not Simple—Attempt to Breed a Strain of Livestock That Will Produce an Unusual Number of Young Seems Practicable

IF animals which normally produce only one offspring at a birth could be made, without loss of any desirable qualities, to produce two or three, it would be a distinctly practical application of genetics. One of the necessary preliminaries to such a step is a careful study of cases where twins or triplets are born.

It is not very uncommon for a cow to produce twin calves, but triplets are decidedly rare. One set of them[1] is shown in the accompanying photograph (Fig. 15) from their owner, N. P. Sorensen, of Bellingham, Wash.

This particular case is somewhat puzzling because it seems to be isolated. So far as is known, the mother of these triplets had never produced more than one calf at a time, previous to this; and the sire is not known to have produced any other triplets or twins. Furthermore, the strain to which they belong appears to be no more prolific of twins or triplets, than is any other strain of Holstein-Friesians.

The three calves have grown normally, and the two bulls promise to be valuable breeders. The heifer, however, does not give any indication of sexual maturity, and it is probable that she is what stock men call a "free martin," an infertile female born as a twin to a male (or two males, in this case).

Although no other plural birth has been recorded for this family, it is usual to find, where such a case is investigated, that several plural births have occurred. Raymond Pearl, for example, in tracing the history of the triplet calves shown in Fig. 16, found[2] that their dam had the following record:

Three offspring, one at a time; then two pairs of twins in succession; next triplets; then a single calf and finally the pair of triplets represented in the photograph.

It would appear that, as the cow grew older, the tendency to multiple births increased.

Information in regard to the ancestry was not available in this case, but E. N. Wentworth has reported[3] an instance of twins in three generations, on a farm near Cocheco, N. H.

MODE OF HEREDITY

Data for investigating the heredity of this tendency in livestock are naturally scanty, but in man they are more abundant. The fact that a tendency to bear twins is due to inheritance, is pretty generally accepted, but no one has yet been able to say *how* this

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[1] The mother of these calves is Eldred Clothilde's Josephine 2d, a purebred Holstein-Friesian cow (registry No. 23525) belonging to the famous De Kol strain from which most of the fine Holsteins in the United States are derived. Her sire was De Dikkert 3d's De Kol Paul, 23525, and her dam Eldred Clothilde's Josephine, 50837.

In February, 1910, the cow illustrated was purchased by N. P. Sorensen, of Bellingham, Wash., and since then has produced the following calves:

Caroline Josephine, born May 10, 1910; female 160284.
Adriana Josephine, born April 16, 1911; female 163034.
Sir Johanna Aaggie of Mt. Springs, born April 24, 1913; male 139860.
Joe de Kol, born May 9, 1914, male 154992.
Joe de Kol 2d, born May 9, 1914; male 154993.
Josephine 3d, born May 9, 1914; female, not registered.

The last three calves named are the triplets shown in Fig. 15. The mother was born October 28, 1904. The sire of the triplets is Sir Johanna Aaggie Fayne 10th (No. 81867).

[2] Bull. 204, Maine Agricultural Experiment Station, September, 1912.

[3] Breeder's Gazette, Vol. LXII, p. 133, July 24, 1912.

THREE CALVES AT A TIME

After bearing a single calf three times in succession, the Holstein-Friesian cow here shown suddenly bore triplets. As little is known of her ancestry, it has been impossible to find to what extent heredity is responsible for this multiple birth. From other studies, it is known that heredity is one of the causes of such births. If a thorough investigation of many cases like this were made, ways might be found for getting a strain that would regularly produce at least two calves at a time, instead of one. (Fig. 15.)

tendency is inherited, for the results are irregular. W. Weinberg, whose study dealt with large numbers of cases, decided[4] that in man the tendency toward multiple births is inherited in Mendelian fashion, apparently behaving as a recessive; but the results did not altogether bear out this simple statement, and he concluded that although heredity was at the bottom of it, external factors also played an important part. No single external factor was as important as heredity, he thought, but the sum total of external factors was probably more important than heredity.

Weinberg's methods of investigation, being statistical, were hardly sufficient to decide this point, and all that can be said at present is that heredity is at least an important factor in the production of plural births.

Few attempts to increase the fecundity of a strain by selecting the animals which produce an unusual number of young, are on record. To a certain degree, of course, such selection is always going on, half unconsciously, for animals which are poor breeders are discarded, while those which are good breeders are valued highly and bred

[4] Archiv für Rassen- und Gesellschafts-Biologie, Band 6, pp. 339, 470, 609, 1909.

THEIR MOTHER HAD FOURTEEN CALVES AT EIGHT BIRTHS

She is a grade Guernsey, while the sire was a grade Hereford. The male calf (in the center) resembled his mother in color and markings, while the other two (infertile females or "free martins") inherited the color and markings of their father, including the white face which is so characteristic of the Hereford breed. Photograph reproduced by courtesy of the Maine Agricultural Experiment Station. (Fig. 16.)

regularly. But deliberate attempts, extending over a series of generations, have rarely been made.

EXPERIMENT OF DR. BELL

One of the most notable experiments is that of Alexander Graham Bell, who for a quarter of a century bred his sheep steadily with a view to getting the ewes to produce more young at a birth. His method of procedure[5] was to select for breeding each year the ewes which had extra nipples, above the single pair regularly present. There appears to be an association between extra nipples and extra fecundity. When Dr. Bell disposed of his flock, a short time ago, he had built it up to a point where none of the ewes had less than four nipples and many of them six, and where twins were produced in a large majority of the births.

Having kept a careful record of his flock, Dr. Bell was able to find some of the external conditions that seem to be involved in the production of twins in sheep. Among them are maturity of the mothers, mating in October, and a rapid increase of weight at the time of mating with subsequent loss of weight. The last-named factor was controllable, and he had some success in increasing the number of twins born, by feeding up the sheep just before mating, and letting them lose weight afterward.

So far as is known to the writer, no such attempt at breeding for fecundity has ever been made with cattle. It would be a tedious and expensive undertaking, but if the character is really inheritable, one ought to be able to breed it into other animals, after it had once been "fixed" in a given strain. It would therefore appear that the attempt to produce a family of cows that would yield a large proportion of twins and triplets, might be a practicable and profitable proceeding.

[5] See THE JOURNAL OF HEREDITY, Vol. V, No. 2, pp. 47–57; February, 1914.

WILD TURKEYS

Domesticated by American Aborigines—Hybridity of Present Stocks—Habits of Birds in the Woods Changes Produced Under Domestication

Review of a Book by EDWARD A. McILHENNY, *Avery Island, La.*

LARGE and handsome, the wild turkey has inevitably attracted constant attention since the days of the first explorers of America. The literature to which it has given rise is considerable, but it is doubtful whether any writers give a more accurate close-range view of the fowl than do those of the book here reviewed.[1]

As to the first appearance of the bird on this continent, authorities differ. Marsh described a species under the name of *Meleagris altus* from the Post-pliocene deposits of New Jersey, which is now held to be the same as Cope's *M. superba* from the Pleistocene of the same state. The material on which this species was based consisted of a few damaged leg-bones, which Dr. Shufeldt, who reviews the subject in the present book, thinks may not have belonged to a turkey at all. The same may be said of another of Marsh's prehistoric species, *M. antiquus*, described from a wing-bone found in Colorado; and to still another species, *M. celer* Marsh, re-created from a few doubtful bone fragments which, it is admitted, may not all have belonged to the same individual.

In short, a careful re-examination of the case shows no well-authenticated turkeys in the geologic record of America. Doubtless they existed, but we have not the material to prove it; and, as Dr. Shufeldt says, "It is often a positive detriment to science, in my opinion, to create new species of fossil birds upon the distal ends of long bones, and surely no assistance whatever to those who honestly endeavor to gain some idea of the avian species that really existed during prehistoric times."

When we come to the historic period, however, we at once find the turkey in practically all the wooded country of North and Central America. The first description seems to have been given by Oviedo in the thirty-sixth chapter of his "Summary of the Natural History of the Indies," which appeared about the year 1527. "He speaks of it as a kind of Peacock found in New Spain, of which a number had been transported to the islands of the Spanish Main and domesticated in the houses of the Christian inhabitants."

IMPROVED IN MEXICO

The Spaniards found them thoroughly domesticated in Mexico, the tame breed having been brought to a size twice that of the wild birds, and the Aztec emperor Montezuma is said to have raised thousands of them to feed the animals of his zoological garden. From Mexico or Yucatan they were introduced to Europe, having reached England, apparently, as early as the year 1524, and quickly becoming very plentiful there. From England and Spain they spread over the rest of the continent.

As the Mexican turkey differs in many respects[2] from those of the United

[1] The Wild Turkey and Its Hunting. By Edward A. McIlhenny. Illustrated from photographs. Pp. 245, price $2.50 net. New York, Doubleday, Page & Co., 1915. The book was written by Mr. McIlhenny largely from notes left by Charles L. Jordan; two chapters are contributed by Dr. R. W. Shufeldt, of Washington, D. C.

[2] The systematic position of the various turkeys has been much disputed. At present the North American forms are all credited to one species, *Meleagris gallopavo*, the type of which is furnished by the Mexican bird, while four subspecies are distinguished in the United States. In Greek and Latin the name Meleagris designated the Guinea-fowl, and the early writers on the turkey appear to have thought they were dealing with a variety of that bird. The name *Turkey* was formerly thought to be related in some way to the Turks, but is now believed to be either an American Indian name or to be derived from the call of the bird itself.

WILD TURKEYS COMPETING FOR A MATE

These two males have been attracted by a photographer, who is hidden in the brush and imitating, with a caller, the love note of the turkey hen. The males stalk up and down, in such a case, and go through an elaborate performance for the purpose of impressing the hen. The one at the left is just beginning the "strut," which is described in the text. Photograph from "The Wild Turkey and Its Hunting." (Fig. 17.)

States, the result has been that the domesticated turkeys of Europe differ somewhat from those of the United States. During the last century the various forms have been crossed and intercrossed in the United States, so that the domestic flocks of bronze turkeys mostly contain recent infusions of wild-turkey blood, while the wild flocks have a great deal of domestic blood. On this point we read:

"In countries thickly settled, as in the one where I now write, there is a great variety of wild turkeys scattered about in the woods of the small creeks and hills. Many hybrid wild turkeys are killed here every year. The cause of this is: every old gobbler that dares to open its mouth in the spring is within hearing of farmers, Negroes, and others, and is a marked bird. It is given no rest until it is killed; hence there are few or no wild turkeys to take care of the hens, which then visit the domestic gobbler about the farmyards. Hence this crossing with the wild one is responsible for a great variety of plumages.

"I once saw a flock of hybrids while hunting squirrels in Pelahatchie swamp, Mississippi, as I sat at the root of a tree eating lunch, about 1 o'clock, with gun across my lap, as I never wish to be caught out of reach of my gun. Suddenly I heard a noise in the leaves, and on looking in that direction I saw a considerable flock of turkeys coming directly toward me in a lively manner, eagerly searching for food. The moment these birds came in sight I saw they had white tips to their tails, but they had the form and action of the wild turkey, and it at once occurred to me that they were a lot of mixed breeds, half wild, half tame, with the freedom of the former. I noticed also

among them one that was nearly white and one old gobbler that was a pure wild turkey; but it was too far off to shoot him. Dropping the lunch and grasping the gun was the work of but a second; then the birds came round the end of a log and began scratching under a beech tree for nuts. Seeing two gobblers put their heads together at about 40 yards from me, I fired, killing both. The flock flew and ran in all directions. One hen passed within 20 paces of me and I killed it with the second barrel. A closer examination of the dead birds convinced me that there had been a cross between the wild and the tame turkey. The skin on their necks and heads was as yellow as an orange, or more of a buckskin, buff color, while the caruncles on the neck were tinged with vermilion, giving them a most peculiar appearance; all three of those slain had this peculiar marking, and there was not a shadow of the blue or purple of the wild turkey about their heads, while all other points, save the white tipped tail feathers, indicated the wild blood."

INCREASE IN BRAIN POWER

It appears that there are numerous small anatomical differences between the typical wild and typical tame turkey, one of them being a difference in the size of the brain cavity. "Mentally the average wild turkey is stronger than the average domesticated one, and I believe it will be found that in all these long years the above influences [of domesticity] have affected the size of the brain-mass of the latter species in the way above indicated, and perhaps it may be possible some day to appreciate this difference. Perhaps, too, there may have been also a slight tendency on the part of the brain of the wild turkey to increase in size owing to the demands made upon its functions due to the influence of man's nearer approach and the necessity of greater mental activity in consequence."

Data are still lacking to determine precisely the extent to which the wild turkey changes in a few generations of domestication. J. D. Caton, who has bred many wild turkeys in captivity, writes on this point:

"My experiments establish first that the turkey may be domesticated, and that each suceeding generation bred in domestication loses something of the wild disposition of its ancestors. Second, that the wild turkey bred in domestication changes its form and the color of its plumage and its legs, each succeeding generation degenerating more and more from these brilliant colors which are so constant in the wild turkey of the forest, so that it is simply a question of time—and indeed a very short time—when they will lose all their native wildness and become clothed in all the varied colors of the common domestic turkey; in fact, be like our domestic turkey—yes, be our domestic turkey."

The loss of this plumage must be a bitter pill for the male to swallow, if we are to accept the picture of him which is vividly painted for us. He is a regular Turk, we are informed, polygamous in the extreme and desirous above all of a well-filled harem. "He cares not a bit for the rearing or training of his family; in fact, it has been alleged that he follows his mates to their nests and destroys and eats the eggs. This I do not believe, nor will I accuse him of such conduct. He is a vain bird and craves admiration, and acts as if he were a royal prince and a genuine dude, and he will have admiration though it costs him his life. He is a gay Lothario and will covet and steal his neighbors' wives and daughters; and if his neighbors protest, will fight to the finish. He is artful, cunning, sly, at the same time a stupendous fool. One day no art can persuade him to approach you, no matter how persuasively or persistently you call; the next day he will boldly walk up to the gun at the first call and be shot. He has no sentiment beyond a dudish and pompous admiration for himself, and he covets every hen he sees. He will stand for hours in a small, sunny place, striving to attract the attention of the hens by strutting, gobbling, blowing, and whining, until he nearly starves to death. I believe he would almost rather be dead than

to have a cloudy day, when he is deprived of seeing the sun shining on his glossy plumage; and if it rains, he is the most disconsolate creature on the face of the earth."

SEXUAL SELECTION

Thanks to the activity of hunters, males are much fewer than females; consequently the polygamous nature of the bird is favored. Beyond this, however, it appears that there is a considerable amount of sexual selection, many gobblers having large harems while others remain unmated. At mating time the males often fight each other, but the writer contradicts Audubon's statement that the weaker are then killed by the stronger. "I have seen many encounters as he describes, but have never in all my life seen one gobbler killed by another, or even crippled, although I have seen two or three birds fight together for hours at a time. Nor have I ever found a gobbler dead in the woods as the result of such an encounter, or even in a worried condition. I have killed many old gobblers and found their necks and heads covered with blood, with spur punctures all over their breasts; but this never stopped them from gobbling, nor are these wounds deep, as the spur, which is an inch and a quarter long in the oldest of them, can only penetrate the skin of the body after passing through the heavy mail of the thick, tough feathers."

Although such an idea is regarded with disfavor by many biologists at the present time, the writer's account indicates that he considers sexual selection to be dependent principally on the selective choice of the hens, whom the males endeavor to attract by the well-known "gobble," and a variety of other evolutions which are thus described:

"In the early morning, during the spring, a gobbler will fly from his roost to the ground, strutting and gobbling, whether a hen is in sight or not; this is done to attract the hens, and it is then you will hear the puffs to which Audubon refers. This sound is produced by the gobbler in expelling the air from its lungs, at the beginning of the strut, the sounds and motions of which have never been satisfactorily described. While going through the strut the gobbler produces a number of notes and motions that are of interest; first, the wings are drooped until the first six or eight feathers at the end of the wings touch the ground; at the same time the tail is spread until like an open fan and erected at right angles to the body; the neck is drawn down and back until the head rests against the shoulder feathers, and the body feathers are all thrown forward until they stand at about right angles to their normal place. At the same time the body is inflated with air, which, with the drooping wings, spread tail, and ruffled feathers, gives the bird the appearance of a big ball. Having blown himself up to the full capacity of his skin, the gobbler suddenly releases the air, making a puff exactly as if a person, having inflated the cheeks to their full capacity, suddenly opens the mouth. As the puff is given, the bird steps quickly forward four or five paces, dragging the ends of the stiff wing feathers along the ground, making a rasping sound; he throws forward his chest, and, gradually contracting the muscles, forces the air from his body with a low, rumbling boom, the feathers resuming their normal position as the air is expelled. Three distinct sounds are produced: *Puff*, *cluck*, *b-o-o-r-r-r-m-i*. At the termination of the gobbling season the primaries of the wings, which are used to produce the cluck, are badly worn by the continued dragging on the ground."

PRESERVING THE TURKEY

A performance of this sort is naturally conspicuous and since the days of Audubon it has been prophesied that the wild turkey would soon become extinct, due to the activity of hunters who follow his call from considerable distances (it is said the gobble can be heard for two miles in favorable atmospheric conditions). There is no game, however, we are told, that holds its own so well as the wild turkey. In the southern states the bird is still to be found in reasonable abundance, and, says the writer, "if these states will protect them

by the right sort of laws, I am of the opinion that the birds will increase rapidly, despite the encroachment of civilization and the war waged upon them by sportsmen. It is not the legitimate methods of destruction that decimate the turkey ranks, as is the case with the quail and grouse, but it is the nefarious tricks the laws in many states permit, namely, trapping and baiting. The latter is by far the most destructive, and is practiced by those who kill turkeys for the market, and frequently by those who want to slaughter these birds solely for count. No creature, however prolific, can stand such treatment long. The quail, though shot in great numbers by both sportsmen and market hunters, and annually destroyed legitimately by the thousands, stand it better than the wild turkey, although the latter produces and raises almost as many young at a time as the quail.

"There are two reasons for this: One is, the quail are not baited and shot on the ground; the other reason is that every bobwhite in the spring can, and does, use his call, thus bringing to him a mate; but the turkey, if he dares to gobble, no matter if he is the only turkey in a radius of 40 miles, has every one who hears him and can procure a gun, after him, and they pursue him relentlessly until he is killed. Among the turkeys the hens raised are greatly in excess of the gobblers. This fact seems to have been provided for by nature in making the male turkey polygamous; but as the male turkey is, during the spring, a very noisy bird, continually gobbling and strutting to attract his harem, and as he is much larger and more conspicuous than the hens, it is only natural that he is in more danger of being killed. Suppose the proportion of gobblers in the beginning of spring is three to fifteen hens in a certain stretch of woods. As soon as the mating season begins, these gobblers will make their whereabouts known by their noise; result—the gunners are after them at once, and the chances are ten to one they will all be killed. The hens will then have no mate, and no young will be produced; whereas, if but one gobbler were left, each of our supposed fifteen hens would raise an average of ten young each, and we would also have 150 new turkeys in the fall to yield sport and food. It has always been my practice to leave at least one old gobbler in each locality to assist the hens in reproduction. If every hunter would do this the problem of maintaining the turkey supply would be greatly solved."

The Age of Parenthood

There is a widespread idea that people formerly married very early in life, and now marry very late. Census figures have demonstrated that as far as concerns the United States, during the past half century, young people are marrying today at an earlier average age than formerly. Genealogical data compiled by Charles Nutt of Worcester, Mass., indicate that five or six generations ago marriage took place at about the same time as nowadays. In the Colonial period, he finds that the average age of parents at the time their children were born is about 31 years. This is an indirect way of getting at the facts, but it tallies with the investigation of C. L. Redfield, who found that the average age of fathers was 32 and of mothers 29, in a large number of New England families. As families were larger formerly than now, it is evident that parallels between the ages of parents then and now must be drawn with care, if based on such averages as those here given.

BREEDING FARM CROPS IN IOWA

H. D. Hughes, *Ames, Iowa*

THE Farm Crops Section of the Iowa Experiment Station has under way breeding projects with oats, winter wheat, barley, corn, timothy, and red clover.

1. *Oat Breeding.* (In cooperation with Bureau of Plant Industry, United States Department of Agriculture.)

The present projects in oat breeding were begun in 1906. The work consists primarily, first, of isolating and testing pure lines from commercial varieties, and second, breeding pure lines from crosses.

Several hundred pure lines have been isolated annually from the various commercial varieties which have given greatest promise in our variety test plats. These pure lines have been tested in head and nursery rows for growth, vigor, and productivity. Those which appeared most promising have been increased and tested under field conditions. In all, something over 8,000 pure lines have been isolated and tested during the years 1906 to 1914. One hundred and twenty-five pedigreed varieties are now included in our variety tests. Two of the most promising have been distributed to farmers in sufficient lots to plant one acre of each, the pedigreed oats being compared under field conditions with the best commercial varieties which the farmers have been able to secure. In 1913 the pedigreed oat, "Iowa 103," outyielded commercial varieties approximately five bushels per acre. In 1914 the pedigreed varieties, "103" and "105," each outyielded the commercial varieties more than four and one-half bushels per acre.

Prior to 1908, J. D. Norton, of the Bureau of Plant Industry, made a large number of crosses. The product of these crosses was transferred to the Iowa Experiment Station in 1909. Several thousand selections have been made and tested in the nursery. The most promising of those that have proved to be pure lines have been increased and are being tested in the variety test plats and comparisons made with commercial varieties and other pure lines.

2. *Winter Wheat Breeding.*

This project started from a foundation stock of eleven different varieties in 1906. From these, several hundred pure lines have been selected and tested out annually in head and nursery rows. During the past four years at least 500 heads have been secured annually from fields away from the station. During the years 1906 to 1914 approximately 8,000 pure lines have been tested out and either multiplied or discarded. Some 150 pedigreed strains are under comparison in twentieth-acre plats and others are being compared in tenth-acre plats. Seed sufficient to plant one acre of the two most promising and best growing varieties, "Iowa Nos. 404 and 327," have been distributed to each of a number of farmers in various portions of the State, these to be compared with a plat of similar size planted under the same conditions, using the best commercial seed which they could get. In 1913 these pedigreed varieties outyielded the commercial sorts an average of one and one-half bushels per acre.

3. *Barley Breeding.*

This project was begun in 1911, the object being to produce strains or varieties of barley suitable for brewing purposes and which could be successfully grown on the drift soils of Iowa. After comparing various varieties in variety test plats for several years, pure lines were isolated from the most promising, these being tested out in head and nursery rows.

4. *Breeding Silver King Corn for Northern Iowa.*

This work was begun in the spring of 1910 when 300 of the best ears of Silver King corn which could be secured were planted in ear to row trials. During

the five years 1910 to 1914 over 1,000 ears have been tested out in this way. Approximately 10 per cent. of the mother ears showing the best performance have gone into the crossing plats, the best of these crosses going into multiplication and into field trials. Some fifty-seven crosses have been tested out at the breeding stations and the progeny of about ten of these crosses has been distributed to several hundred farmers in the northern part of the State for comparison with their own corn. In 1913 the improved Silver King out-yielded all varieties with which it was compared, an average of approximately five bushels per acre.

5. *Reid's Yellow Dent Breeding Work.*

A definite project looking to the improvement of the ordinary Reid's Yellow Dent was begun at Ames about 1905. From 1905 to 1914 over 2,000 selected ears of Reid's Yellow Dent corn have been tested out in ear to row plats. The ears showing the best field performance are carried over each year to go into the crossing plat.

One very desirable strain known as "Iowa 203" has been developed, which, in test trials, has an average of about twelve bushels per acre over ordinary Reid's from which it came. Enough corn to plant one acre was supplied last year to each of several hundred farmers in central Iowa for comparison with their own corn.

6. *Breeding Red Dent Corn.*

The purpose of this investigation is to determine the prepotency of the color character in Reid's Yellow Dent corn. This investigation was begun in 1913, so that it has been under way for only two seasons. During each of these seasons the per cent of red and yellow ears produced by different shades of red mother ears as well as by yellow ears with red parentage has been noted. In 1914 some 20,000 hills were included in the test.

7. *Correlation Studies with Corn.*

The object of this investigation is to determine the relation between the ear characteristics of seed ears and yield, also the relation between the stalk characteristics of the plant producing the seed ear and the yielding power of the ear.

The characteristics of the various seed ears which have been planted in ear to row test plats have been noted in a study of the relation between the character of the ear and yield. So far the work has consisted simply in securing the data. We propose to compile this data in the near future. This part of the work was begun in 1907.

The study of stalk characteristics as related to yield was begun in 1910 when full and detailed notes were made on the characteristics of some 500 stalks grown under different climatic conditions. The ear produced by each stalk was saved and planted in a separate plat the second year, when the yield was determined. From 400 to 500 individual plants and an equal number of plats have been used in this work each year. While but little of this data has been compiled, we believe that some rather striking correlations between the character of the stalk and the yielding power of the ear will be found.

8. *Timothy Breeding.*

This project was begun in 1910 when some 3,000 plants were put out in the nursery. From approximately 300 strains compared in row trials some twenty have been advanced to multiplication plats where they are under further comparison. A few of the best of these will be placed in isolated multiplication plats the coming fall.

9. *Clover Breeding.* (In cooperation with Bureau of Plant Industry, United States Department of Agriculture.)

This project was begun in 1910 when a large number of selections were made from specimens secured in the vicinity of Ames, Iowa. In 1912 we secured from the Bureau of Plant Industry of the United States Department of Agriculture various lots of seed coming from all parts of the world. These were planted in nursery plats where individual plants were seeded and the best individuals isolated for continued breeding and multiplication. Some fifty-five of the best individuals have been multiplied and are being compared for vigor, leafiness, seed production, and resistance to winter killing and disease.

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(Formerly the American Breeders' Magazine)

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CONTENTS

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THESE CONSTRICTED EYELIDS RUN THROUGH FOUR GENERATIONS

Some, but not all, of the members of each generation are born with slit-eyes. The sight is normal, but the individual can see well only by throwing back the head or tilting it to one side, as the children are doing. The father (shown at the left in the above photograph) married a normal woman, and they have had four children. The three boys have eyes like the father's, as is shown by their photograph, above; a girl has normal eyes. (Frontispiece.)

THE SLIT-EYED PEOPLE

Constricted Eyelids Found in Four Generations of a Georgia Family -Vision is Normal—Defect is Not Sex-Linked and Might be a Mendelian Recessive

H. P. Stuckey

Horticulturist, Georgia Experiment Station

WHILE in the mountains of northeastern Georgia last summer, I met a family which is interesting from the standpoint of the geneticist, because of the well-marked inheritance of a peculiar type of eye. One of the men of the family and three of his children are shown in the photograph opposite.

I saw a number of members of the family and made inquiries about others. The pioneer of the family in this section was the great-grandfather of the children whom I photographed, and I have the authority of residents of the locality for saying that he showed this restricted eyelid. Nothing is known about his past, so he must stand as the first individual in our family history.

Nothing being known of his wife, it must be assumed that she was normal. They had a son, whom I saw, and who is the grandfather of the children illustrated in the frontispiece. This man, now elderly, has the constricted eyelids well marked.

He married a woman with ordinary eyes, and they became the parents of nine children, six of whom had the slit-eyes, while three had eyes that were entirely normal. Among the children with the affected eyes are both boys and girls, so it is obvious that the defect cannot be inherited in a sex-linked fashion, as is color-blindness and one form of night-blindness.

These nine children form the third generation of the family history. One of them, the man shown in the frontispiece, married a normal woman, and they have four children, three boys (shown in the frontispiece) with constricted eyelids, and one girl who is quite normal.

The knowledge available therefore amounts to this—that the defect appears in some of the members of four generations, and that it is not limited to either sex. The history might give rise to a suspicion that the trait is a simple Mendelian recessive, but of course the fact could not be established with the data from only one family, and that a small one.

The defect is limited wholly to the lids. The eyesight is perfect, and the affected members of the family are able to earn their living in competition with normal individuals. Due to the constriction of the lids, however, the persons with this trait have difficulty in getting clear vision unless they throw their heads back or turn them to one side, as the children are doing in the picture.

Not being a medical man, I cannot tell the exact nature of this affection—it may be a failure of the nictitating membrane to be absorbed, in which case current theories of heredity would suggest either the absence of the factor for normal development, or the presence of an inhibitor for normal development. But such speculations are of little value when the data are so slender, and I do not offer any hypothesis as to the genetic nature of the case; I merely offer the facts and the photographs, which speak for themselves.

GERMINATING COCONUTS

Huge Seeds Have Remarkable Adaptations for Growing in Dry Climate—Cavity in Nut Serves Like a Stomach or Wet Nurse for the Young Plant—The Coconut not Naturally a Sea-shore Palm and Not Dispersed by Sea

O. F. Cook and C. B. Doyle

Bureau of Plant Industry, U. S. Department of Agriculture, Washington, D. C.

COCONUTS are seeds. They are the largest of all seeds, except the so-called double coconuts of the Seychelles Islands, in the Indian Ocean, which are the seeds of a huge fan palm (*Lodoicea sechellarum*). The double coconuts are five or six times the size of true coconuts, weighing 30 to 40 pounds each. No other seed approaches the size of a large coconut, and few seeds, if any, afford such interesting specializations to assist in the germination and growth of the young plant. These special characters or adaptations are of the utmost interest as affording the best illustrations of the influence of selection upon the progress of evolution.

The germinating coconut has been studied in detail by several authors from the structural and chemical standpoints, but the remarkable internal growth of the embryo has not been adequately described and illustrated. Several varieties of coconuts sent from Panama were received in a germinating condition, so that it was possible to get photographs of the stages of germination as well as of the varietal differences.

THEORY OF DISTRIBUTION BY SEA

Appreciation of the specialized characters of the coconut has been hindered by the theory of maritime distribution. The coconut has been described very often in books of travel and natural history, and even in formal scientific works, as a plant that has been widely distributed in nature through the agency of ocean currents. It has always been considered a native of tropical sea-coasts, specially equipped for floating to other coasts and islands. It is true that the coconut is provided with a tough fibrous husk from one to two inches thick, which enables it to remain afloat for a long time. It is also provided with a coating of wax on the surface of the husk, as though to render the nut impervious to water. It is not surprising, therefore, that writers who approach the subject from the standpoint of structure alone should continue to rely on this apparently unimpeachable proof of the habits of the plant in nature.

There is no direct evidence, however, to support this theory, for the same type of husk is found in the seeds of many other related species of palms which do not grow on sea-coasts, and are not distributed by water. That the husk of the coconut is thicker than that of the other related species, merely conforms with its larger size and the greater danger of breakage when falling to the ground. The waxy coating of the husk is not a unique character, for it is found in nearly the whole group of palms, the small fruits of many inland species being more waxy than the coconut.

NEAR RELATIVES ARE AMERICAN

All of the palms that are closely related to the coconut are natives of America, most of them being found in Brazil. It is true that the coconut palm is most abundant and attains its greatest economic importance in the islands of the Pacific, but there is nothing to show that the habits of the palm would enable it to exist permanently, or in a truly wild state, in a littoral or oceanic environment. Although this idea of the coconut as a native of the Pacific islands appears in most of the text-books and general works of refer-

THE COCONUT ENCLOSED IN ITS HUSK

Sprouting coconuts from Panama, representing three varieties with different shapes. The sprouts show that the nut on left had germinated in an upright position; that on the right while lying on its side. (Reduced.) (Fig. 1.)

ence, it is entirely contrary to the opinion of writers who have been familiar with the actual conditions and behavior of the palm in the Pacific. Such writers agree that there are no wild palms, that the presence of coconuts is everywhere the work of man, and that the palms do not survive for any great period the withdrawal of human assistance.[1]

ADAPTATIONS FOR GERMINATION

The unique habit of the coconut of preserving a store of water in the interior cavity of the seed, the very large amount of food material stored in the "meat" of the nut, and the very thick, tough, fibrous husk are the most specialized features. Assuming that these peculiarities were necessary to assist in germination, it is reasonable to believe that the coconut palm must have developed in a relatively dry climate, where the young plants had to grow to large size before they could reach supplies of moisture in the soil.

Such extensive provisions for the storage of food and water would seem to be unnecessary in a maritime plant able to draw moisture from sandy beaches flooded twice a day by the tides. The distance to permanent moisture on a sandy beach is very short; in fact the sand is never really dry at all except at the surface. For a plant able to thrive on a salt solution, a covering of an inch or two of sand would be sufficient protection against drying out. The great size of the nuts would be a disadvantage for a seashore palm as keeping the seeds from being buried in the sand. The palms that live on the seashore, such as our southern palmettoes, all have small seeds.

It is only when we think of the coconut as growing in an interior region with an alkaline soil and subject to prolonged drought, that we can appreciate the significance of the large seed, or think of the large store of food and moisture, and the very thick husk as characters that give the palm special adaptation to the natural condition of environment. Many of the palms related to the coconut are forest species, or at least able to develop in partial shade. The coconut, on the contrary, is extremely intolerant of shade, and must have had its development in a region where other vegetation was absent or relatively sparse and open.

MOISTURE IN THE HUSK

The coconut is certainly well equipped to protect the embryo or the young seedling from the danger of drying. In addition to the moisture carried in the meat of the nut and in the central cavity, a still larger supply can be carried in the fibrous husk, and this may even be replenished from rains or other surface water after the young plant has begun to grow, and the husk opened and partly decayed. In addition to thus acting as a sponge, the husk serves the young plant in another way, as a medium for starting the growth of the roots before they enter the soil.

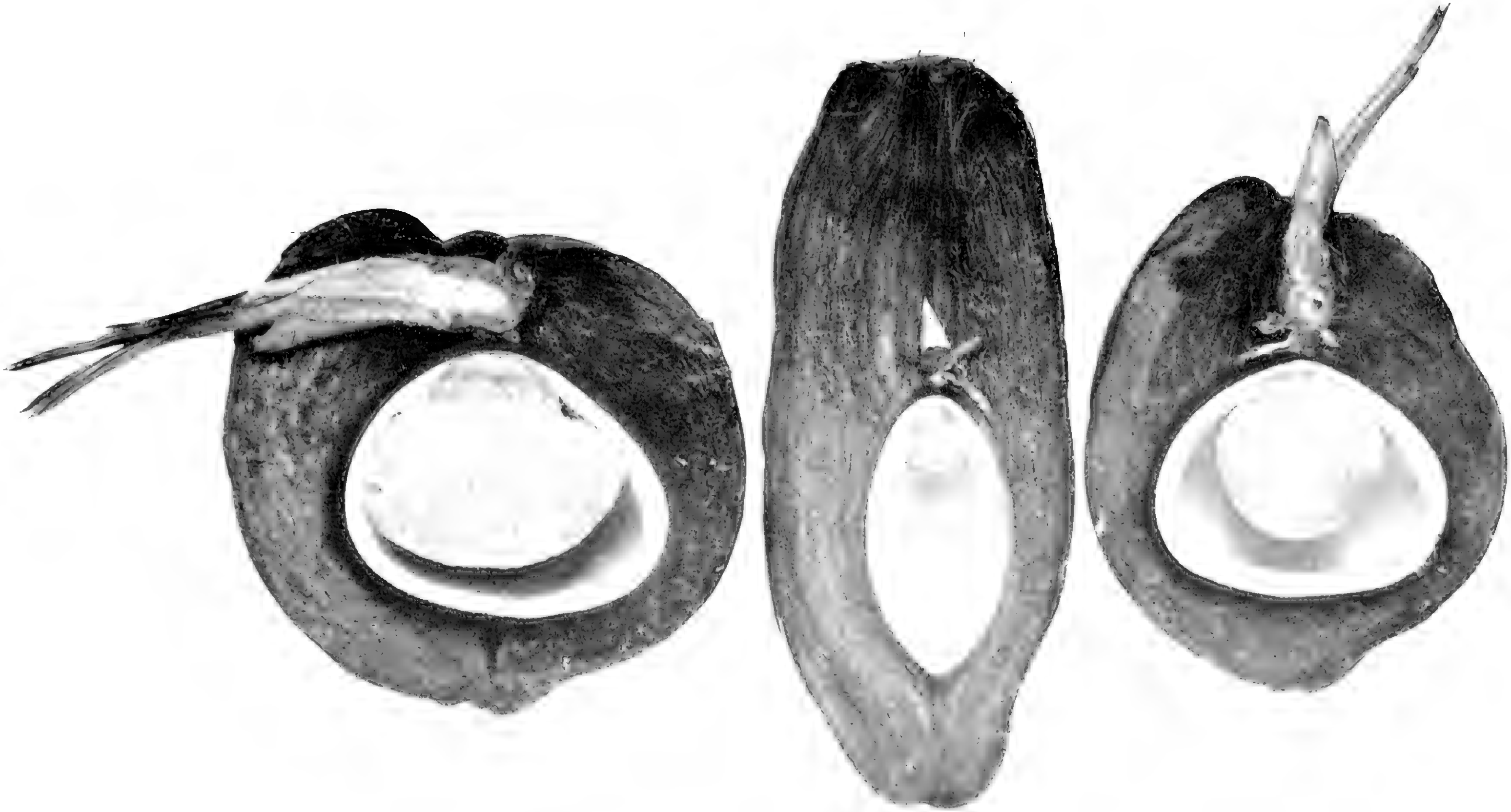
The whole process of germination may be completed inside the husk. And not the germination alone, but the subsequent growth of the young plant, may go on for months without any external contacts, the leaves often attaining considerable size before the roots have extended beyond the fibers of the husk.

A SELF-POTTED PLANT

In the Philippine Islands where thousands of these palms are cultivated, it is often the custom to tie the nuts in pairs and hang them over a pole, fence, or around posts. Under these conditions the nuts will obviously receive no water from the soil, and it is apparent that they require no further attention, for in a few months the young plant has pushed its way through the husk and can be placed in its permanent location in the field.

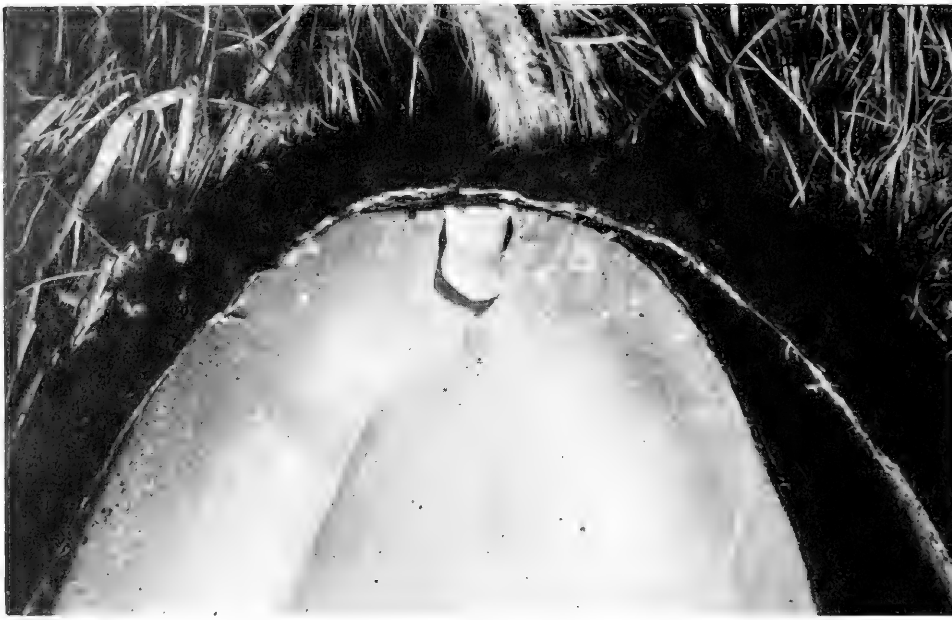
The coconut seedling, with its ample provision for food and moisture and its fibrous husk for the accommodation

[1] Cook, O. F. The Origin and Distribution of the Coconut Palm. Contributions from the U. S. National Herbarium, 7:257–293, 1901. History of the Coconut Palm in America. Contribution from the U. S. National Herbarium, 14:271–342, 1910.



INTERNAL STRUCTURE OF THE COCONUT

Longitudinal sections of the nuts shown in fig. 1, representing three stages in the process of germination, indicated by the different sizes of the cotyledon or "nursing foot" that grows into the central cavity. The cotyledons differ in shape, that on the left having a more distinct shoulder near the point of attachment. Note also the relative size of the cotyledon and sprout in the central figure, the roots of which can be seen growing into the husk. (Reduced.) (Fig. 2.)



WHERE THE TREE GETS ITS START

This ungerminated coconut has been cut open lengthwise to show the embryo, which lies in a small cavity in the meat, at the stem end of the nut. When germination begins the embryo grows at both ends: outward to form the young plant and inward to fill the central cavity and digest the milk and endosperm, thereby supplying nourishment for the growth of the plant. Photograph magnified about $2\frac{1}{2}$ times. (Fig. 3.)

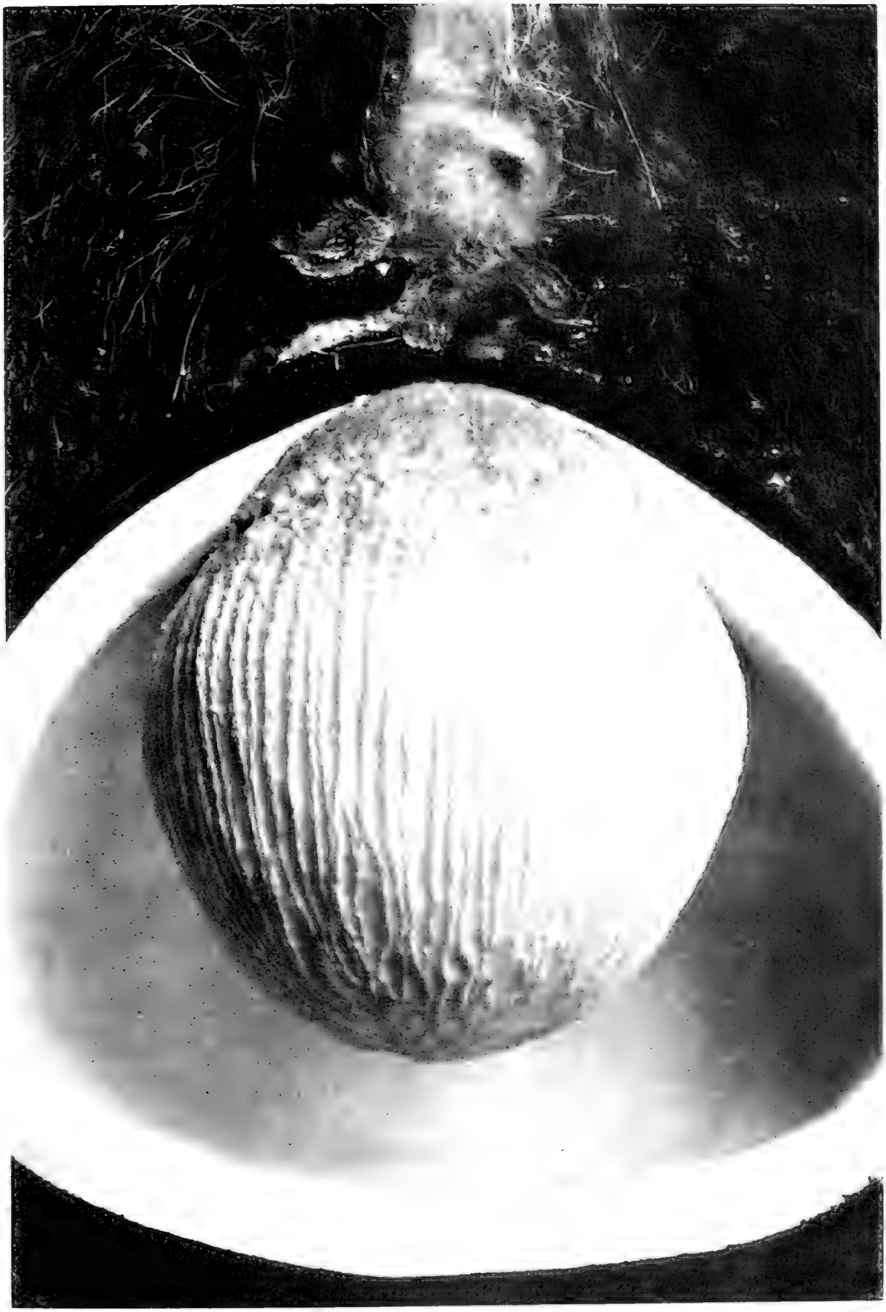
of its roots, may be described as a self-potted plant. So well adapted for this purpose is the coconut fiber that it is in general use by gardeners in Europe and America as a medium for the germination of delicate seeds, or as an ingredient of fine potting soil.

GROWTH OF THE EMBRYO

The use of the husk is still better appreciated when we take into account the remarkable processes that go on inside the shell of the germinating coconut. In spite of the huge size of the other parts of the seed, the embryo or young plant that exists before germination begins is hardly larger than the proverbial grain of mustard-seed. It is cylindrical in form and lies in a small cavity in the endosperm just underneath the largest of the three "eyes" of the shell. There is no direct connection between the embryo and the stored food material, or between the embryo and the "milk" in the central cavity. (See Fig. 3.) In order to utilize these food supplies, the embryo has to take them over by slow processes of digestion and absorption.

When germination begins the embryo elongates and becomes enlarged at both ends. From the outer end arise the plumule and the roots, while the internal growth results in the formation of a large bulbous mass of spongy tissue, pure white in color, with many grooves and narrow ridges running lengthwise on the surface.

All through this spongy mass, technically the cotyledon, are ramifications of vascular strands, which converge and become fibrous and woody at the narrow "neck" which connects the absorbing tissue with the stem. (See Fig. 6.) That the surface of some of these cotyledons is distinctly rougher and more irregular than others can be seen in Figs. 4 and 5. In Fig. 2 the wrinkles are narrow, parallel ridges, while Fig. 5 shows the wrinkles broader and distinctly irregular. Differences in the general shape of these organs are also apparent,



THE YOUNG COCONUT'S "WET NURSE"

Sprouted coconut with husk removed, showing a moderately advanced stage of germination. The cotyledon has swelled and its surface is covered with narrow, regular wrinkles. This surface takes up the "milk" of the nut and supplies it to the young plant above; and also digests the soft layer of "meat" or endosperm. Natural size. (Fig. 4.)

and may afford means of distinguishing some of the varieties.

The function of this cotyledon is to absorb the endosperm and carry the food material over to nourish the growing parts of the young seedling. In order to be absorbed, the food materials stored in the endosperm have to be digested, and the digestion is accomplished by ferments secreted by the cotyledon, as in the familiar change of starch into sugar in the malting of barley and other grains, preceding the formation of alcohol.

THE COCONUT'S STOMACH

The digestion of the endosperm is evidently more rapid at the places where it is in contact with the cotyledon. The softening of the surface elsewhere (see Fig. 5) may mean that the milk of the germinating nut becomes charged with a digestive ferment secreted by the cotyledon. Hence it may be considered that the fluid-filled cavity of the germinating nut, in addition to its storage function, serves like a stomach, to provide for a more rapid digestion and absorption of the stored food materials than would be possible by the direct action of the cotyledon. It is easy to understand that such a system might be very useful to the young plant in enabling it to make more rapid growth in short periods of favorable conditions. If this view is correct, we may think of the milk as being recharged with food materials from the endosperm, to replace those that are absorbed by the cotyledon.

That sugar is present in the cotyledon is evident from the sweet taste of the latter, and the very delicate texture suggesting sponge cake is altogether different from the hard oily "meat" of the nut. These enlarged cotyledons of the germinating nuts are considered luxuries and food for invalids by the natives of the Polynesian Islands and other parts of the tropics. In the native markets of towns along the west coast of Mexico the dried cotyledons are sold under the name of "manzanas de coco" or coconut apples. (See Fig. 6*b*.)

OTHER INTERNAL CHANGES

More detailed studies of what takes place inside the germinating coconut have shown interesting changes in the composition of the food materials. Thus Walker,[2] in his experiments with a selected series of nuts[3] in the Philippines, found that the total quantity of milk shows a marked diminution from 374 grams in an unsprouted nut to nothing when the sprouts had attained a height of 93 centimeters. A decided loss in the sugar content of the milk took place at the same time, falling from 2.3 per cent in the milk from the unsprouted nuts to 0.3 per cent in the ones which had sprouts 38 centimeters long.

A decided loss in the total weight of the meat was also evident, as it dropped from 457 grams in the unsprouted nut to 148 grams in the nut with a sprout 93 centimeters long. The loss seemed to be due to a direct absorption by the cotyledon, the process taking place only in that portion of the meat located near the latter, but increasing rapidly as the cotyledon grows larger and comes in contact with the entire surface of the endosperm. This would be the case, necessarily, if the nuts failed to maintain a supply of liquid in the cavity.

The loss in the total weight of oil was fairly proportional to the loss in the total weight of meat. During the early stages of germination there appeared to be a concentration of oil near the cotyledon, with a corresponding loss in that portion of the meat farthest away.

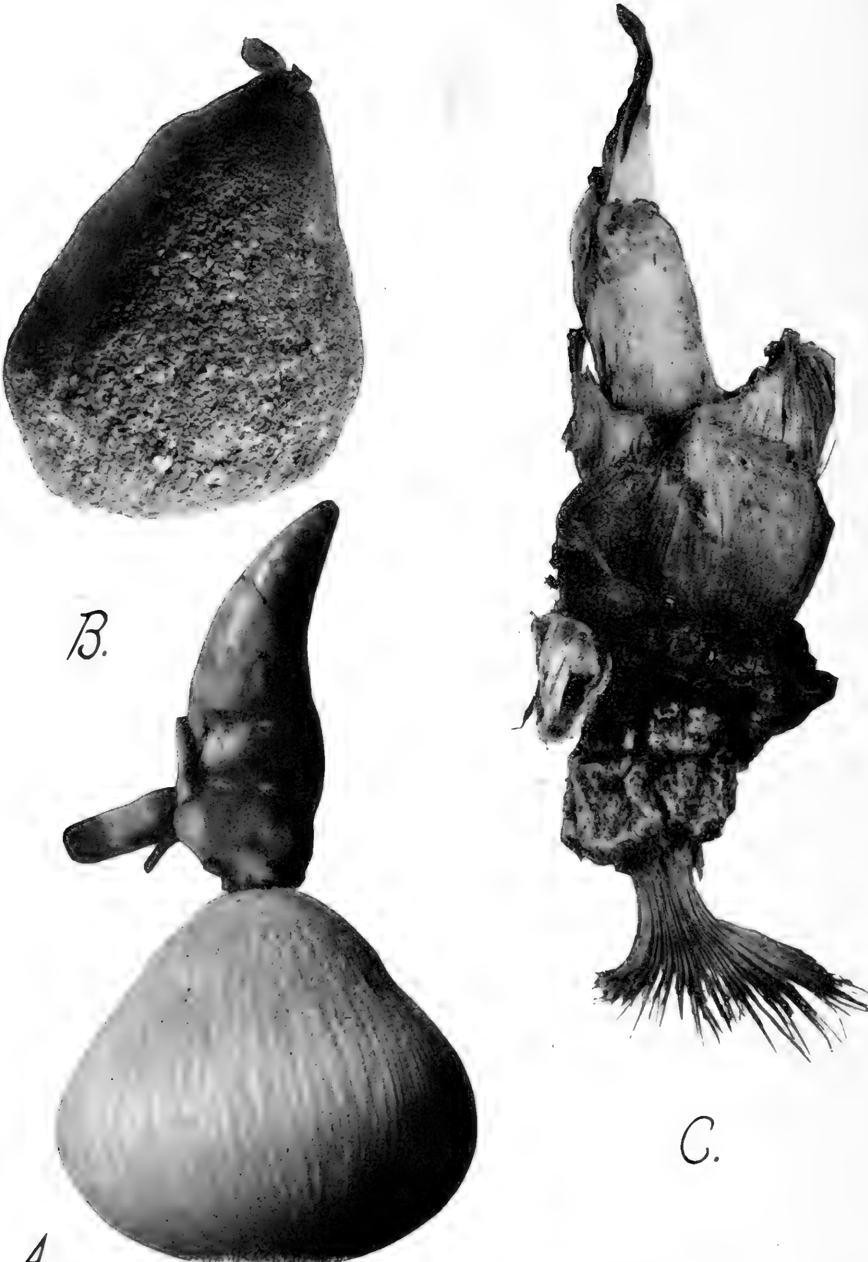
The percentage of sugar decreased from 4.1 per cent in the unsprouted nut to 1.2 per cent in the nut with the longest sprout (93 centimeters.) The loss appeared to be due to the absorption of sugar by the foot, as in all cases less sugar was found in that portion of the nut in direct contact with the cotyledon than in the parts farthest away from the cotyledon.

[2] Philippine Journal of Science, Vol. III, June, 1908.

[3] Four pairs of coconuts of different ages but approximately of the same size were selected for this work by Dr. Walker. The range in the age was from nuts which had not sprouted at all to nuts with a sprout 93 centimeters long.

SPROUTING COCONUT, FARTHER ADVANCED

The surface of the "nursing foot" or cotyledon becomes more corrugated as development proceeds. A soft, watery, partly digested layer of "meat" can be distinguished by its darker color, on the inner surface of the endosperm; this is gradually being digested to supply food to the young plant above. The supply of nourishment may continue for a long time after the roots have been sent into the ground. Permanent supplies of moisture must be reached before the survival of the young plant is assured but the "milk" gives it enough moisture for many months. Natural size. (Fig. 5.)



THE SPROUT AND ITS FOOD SUPPLY

A. Coconut seedling removed from shell showing narrow "neck" between the cotyledon and the sprout through which the nourishment is carried. Natural size.

B. Dried coconut cotyledons called "coconut apples," (manzanas de coco) sold in the native markets along the west coast of Mexico. Natural size.

C. Dried coconut sprout, with the cotyledon removed showing the fibers that arise in the cotyledon and pass through the neck into the base of the young plant. These fibers serve no doubt to convey nourishment to the sprout, as well as to support the cotyledon at the point of attachment. Enlarged about 2½ diameters. (Fig. 6.)

The total weight of the cotyledon increased from 19 grams in the unsprouted nut to 228 grams in the nut with the longest sprout.

The cotyledon weighed 19 grams in a nut that still had no sprout, increasing to 288 grams in the nut with the longest sprout. With the growth of the cotyledon there was a decline in the percentage of sugar, although not in the total quantity, but more sugar was found at the stage when the foot completely filled the nut. It would be expected, however, that the amount of sugar present at any particular time would depend upon temperature, sunlight, moisture, or other conditions that would control the rate of growth of the young plant, or influence the process of digestion of the endosperm. With rapid growth the sugar would be used, while checking of growth would enable new supplies of sugar to be accumulated.

SUMMARY

The unique habit of the coconut of preserving a supply of water in the interior cavity of the seed, the very large amount of stored material or meat, and the very thick, tough, fibrous husk are features that afford an extremely interesting example of specialization to assist in the germination and growth of the young plant.

The cotyledons of the germinating nuts show considerable variation in shape, and also in the markings on the surface. Some of them have rather shallow, parallel ridges, while others are deeply and irregularly furrowed.

The formation of a soft, watery, superficial layer on the endosperm after germination begins indicates the presence of an active fat-splitting principle in the milk, which partly digests the meat and transforms it into such a condition that it can be readily absorbed by the growing cotyledon.

Eugenics Research in Bohemia

An institution for research in eugenics was founded in Prag, Bohemia, on July 12, 1913, by Drs. Karl Herfort and Arthur Brozek, who propose to make studies of the family history of school and hospital children in that city. Announcing their work in *Eos* (X, 3, 161–173, July, 1914) they report the preliminary study of fifty-six cases of feeble-mindedness, none of which was congenital. In almost all cases, however, the family stock was neuropathic. They conclude that from the marriage of two individuals, each of whom is neuropathic but neither of whom is feebleminded, one or more of the children is likely to be feebleminded. Discussing the Mendelian heredity of feeble-mindedness, they conclude it is not a unit character but that it is due to multiple factors. The neuropathic constitution, they conclude, is a complex made up of a large number of inherited dispositions; and as the different parts of this complex are inherited separately, there is naturally wide variation observed in the character of neuropathic individuals.

Encouragement for Superior Parents

Discussing the methods of constructive eugenics, leading to an increase in the number of highly gifted individuals in the race, Dr. von Gruber (in Archiv für Frauenkunde und Eugenetik, II, 1, 109) favors grants for education of children and pensions for parents. To give money to parents for the education of superior children would, he thinks, make such children regarded as an asset, and inferior children as a liability; not only would this lead parents to have large families, if they came of superior stock, but it would lead young people to regard the pedigrees of their prospective life-partners with more care, if they realized that intelligent choice in marriage was of distinct economic importance. The attention of citizens would thus come to be directed to the fact that superior children are of real value to the state and to their parents.

SUCCESS IN CONTROLLING SEX

Male-producing and Female-producing Eggs Regularly Distinct in Pigeons—Whitman-Riddle Experiments Result in Making Each Kind of Egg Produce Opposite Sex, Under Some Conditions—New View of Nature of Sex—Application to Human Society

WE TALK a good deal about the possibilities of sex-control—we who are interested in breeding. We would be much pleased if we could secure an excess of one sex, instead of the half-and-half which we usually get. If we could mate fowls in such a way as to produce *nothing but* males, or *nothing but* females, we would think we had reached the farthest goal conceivable—in that direction.

But an approximation to such a result has been obtained. Under exceptional circumstances, it is true—but given those circumstances, it is being done continually.

Professor C. O. Whitman, one of the greatest among the investigators and teachers of biology, who died in **1910**, learned the basis upon which such matings may be made. After his death his work was continued by Dr. Oscar Riddle, who is getting the same results at the Carnegie Institution's laboratory for the study of experimental evolution, in Cold Spring Harbor, Long Island. Dr. Riddle, moreover, undertook, and is still engaged in, a special study of many aspects of these matings, in an attempt to decide whether a real, or only an apparent, sex control is involved. His answer has already been given—a reversal of sex has been effected. The results of these investigations are not yet published, but from the addresses, abstracts and short papers of Dr. Riddle, beginning in **1911**, a fairly comprehensive survey of results may now be obtained.

To understand their results, let us first see what happens when we make a very *wide* cross in pigeons and doves, the material of their experiments. Ordinarily breeders mate members of the same species. Sometimes we can mate members of different species. Occasionally we can mate individuals of the next higher division, a genus; but we consider that a very wide cross. It is not often that we can go into the division above this, and mate members of two different families. But it can be done with pigeons.

Now when birds (not hybrids) of two different families are mated, the offspring produced are all males. In the whole history of the study there have been but two exceptions, and one at least of the females then produced was not perfect; the sexual development was rudimentary.

Here, then, we have a certain kind of sex-control, for we find that we can produce all males from a cross of two different families. So wide a cross as that hardly ever takes place in artificial breeding, and probably much less often or never in nature. But it suggests to us that if we are to get an insight into sex-determination, we must depart from the normal conditions as far as possible.

GENERIC CROSSES MADE

Dr. Riddle has found it most convenient, in view of Whitman's earlier results, to work with crosses of two different genera. From such a mating, the eggs produced in spring and early summer hatch into all or nearly all males. But if such a pair of birds are made to "overwork at reproduction," *i. e.* if they are not allowed to incubate their own eggs, and are made to lay eggs very rapidly, a pair each week or so, it will be found that as the season grows later, the eggs laid become progressively "weaker," until those near the end of the laying period will hatch with difficulty or not at all. From those eggs that do hatch from the birds which

become more and more exhausted, the proportion of females produced from their eggs becomes higher. Younger birds not previously "overworked" are not easily exhausted in this manner; but previously "overworked" old birds, under continued "overwork," will cease the production of male offspring earlier in the spring or summer than did these same birds during previous years; and from then on to the end of the egg-laying period, their eggs will hatch out all or nearly all females.

Now everyone knows that this is not what usually happens among birds. There are two unusual situations or elements involved in obtaining these results: first, a wide cross; and second, an enforced increase of "reproductive overwork." In ordinary matings of pigeons and of other fowls, the two sexes will hatch out in about equal numbers at any time of year. What is the meaning of this production, first of all males, later of all females, with the "overworked" pigeon in crosses of two different genera?

There are several conceivable explanations. First, it may be true sex-reversal—eggs which were destined to produce one sex may have been forced to produce the opposite sex. If that be the real explanation, we are going to get an insight into the nature of sex and the methods of controlling it. But it is also conceivable that nothing so sensational has happened. Perhaps male-producing and female-producing germs were formed in the usual manner, but for some reason only one kind was fertilized. Or perhaps one kind of germ died in the ovary, so that all the offspring had to be of the sex represented by the other kind of germ, which survived. Or perhaps there is a mechanical internal change in the female-producing germs which turned them into male-producing germs.

In this last paragraph is summed up the whole of the problem which faced Dr. Whitman and Dr. Riddle. To the biologists, it is a much bigger problem than it may appear to be on its face, for they know that ordinarily two kinds of germs are produced, one of which will give rise to males and the other to females, and it puts a very heavy strain on many accepted theories, to believe that one of these kinds could be made, *by pressure upon the germ during its growth period*, to produce contrary results to what the normal mechanism does. A change in the internal structure of the cell involving chromosomal change, or elimination, could perhaps, on current views, be accepted without great difficulty; but if Dr. Riddle demonstrates that he has changed the sex-value of the cell without a corresponding change or elimination of the chromosome numbers, he will find, as he is certainly well aware, that biologists here require very rigid proofs.

TEN LINES OF EVIDENCE

Ten different lines of evidence, or correlations with the breeding results, have been developed from the work of Dr. Whitman and Dr. Riddle, and they all seem to point the same way. To Dr. Riddle, only one conclusion is possible from them—namely, that sex has actually been reversed, that male offspring have been hatched from female-producing germs, and vice versa.

The first correlation established results from a study of the size of the ova, that is, the yolks freed from shell and albumen or "white." The yolks of late summer and autumn, those which produce all or mostly females, are distinctly larger than those of the early season, which produce males. The change in size is gradual, and considerable.

The pigeon regularly lays a clutch, two eggs, at an interval of a day or two apart. It was learned that the first egg of the clutch, in this experimental breeding of pure, non-hybrid females was rather regularly—there are exceptions—smaller than the second. Whitman had already shown that in the wild species with which he worked males predominate in hatches from the first eggs of clutches, and females from the second. So the conclusion was possible that males usually come from smaller eggs, both for season, and for egg of clutch; females from larger eggs, the larger of the season and the larger of the clutch.

Still a third situation was found to give evidence that the smaller yolks are male-producing and the larger yolks female-producing. It has already been mentioned that females which are "overworked" tend, when older, to begin the production of females earlier and earlier in the season. Now a comparison of the size of yolks derived from younger and older birds has shown that those of younger (but mature) birds are smaller than those of older birds. This fact has been fully demonstrated.

We have noted three kinds of evidence that smaller yolks produce males, larger yolks females. There is still a fourth piece of proof. It is known that the very first egg of life, and the first egg produced after a long period of rest, more frequently produce a female than do the first eggs of succeeding pairs or clutches. Study of the actual sizes of such yolks has shown that there is a reversal in size of these first eggs, corresponding to the reversal in sex, so that here too the female sex is associated with the larger yolk. Yolk size was accurately determined in about 10,000 cases, and the association of smaller yolk with male producing germs, and larger yolk with female producing germs is well established. The conclusion is drawn that here two kinds of ova are produced, and the kinds may be identified by size differences.

Next, let us recall that in the pigeon (probably in all birds) two kinds of eggs are produced, but only one kind of sperm. There is breeding evidence, in addition to the evidence accumulated by Dr. Riddle, which would seem to establish this fact. The determination of sex therefore resides necessarily in the egg, and the sperm can be ruled out of this discussion.

THE HEART OF THE PROBLEM

We get back to the heart of the problem again. If there are two kinds of eggs—one which produces males, and the other which produces females—how is it that early in the season practically *only* males are produced, and later in the season *only* females? Is there only one kind of egg produced at each period? And is the kind reversed in the two periods?

Quite impossible, Dr. Riddle answers.[1] "We can easily demonstrate, by weighing or otherwise measuring them, that both kinds of eggs are produced throughout. What actually happens is that the 'generic cross' which produces all, or nearly all, males in the spring and all, or nearly all, females in the autumn, is utilizing in the spring a number of female-producing ova for the production of males, and in the later season is utilizing for the production of females ova one-half of which had initial inclination for the production of females." That this is true, is shown not only by weighing the eggs, but by a number of other lines of evidence to be cited later; and also "by the fact that if the same female which threw all males in the spring had been mated with another bird of her own kind, and made to lay eggs at a similar rate, then both males and females would certainly have appeared at all seasons." It is only because we are studying a cross of birds, each from a distinct genus, and applying the pressure of "overwork," that we are upsetting the normal conditions enough to see what is going on beneath the surface.

We have now excluded two possible explanations of the observed sex-control in pigeons. We have shown that it cannot be due to selective fertilization by the sperm—for there is only one kind of sperm. We have shown that it can not be due to selective elimination of ova in the ovary—for it is known that the two kinds of ova—male-producing and female-producing—are being laid all the time.

The next possible objection to the supposition that we are dealing with a real case of sex-control, would be a technical one, alleging that everything which happens might be explained as differential maturation. To this Dr. Riddle answers:

> The maturation would have to be definitely differential in (1) the elimination of an X chromosome during the spring from one-half

[1] In a paper read before the American Society of Naturalists, Columbus, Ohio, December 30, 1915.

the ova, and the retention of this same X in the eggs of identical chromosomal constitution in the autumn. (2) The elimination of a Y chromosome from the other half of the eggs laid during the autumn, and the retention of of all these same Y's in the homologous eggs laid in the spring. Alternative assumptions to (1) and (2) would be that the X's of eggs laid in the spring became Y-like *in the presence of the sperm from a wide cross*, and only then become so; and that the Y's of autumn eggs become *gradually*, in the presence of *any kind of sperm*, more X-like in quality. (3) That all other chromosomes than the sex-chromosomes must display no such thing as a seasonal preference for "staying" or "going," since every observable character of the hybrids betrays an inheritance from both parents. If any one can accept such an incredible hypothesis of chromosome behavior, he must also face this fact: these sex-controlled experiments produce *several grades of females*. Some are quite nearly males, although they lay eggs. Is it too hazardous to suggest that in one and the same egg the Y could hardly have "gone out" to allow the egg to develop into a female, and yet have "stayed in" to deliver the relative masculinity which we easily detect and measure in this same female? If sex is directly the creature of a sex chromosome, the sex situation found in some of my female doves requires that the male-producing chromosome be eliminated from, and retained in, the same egg. In the face of these facts, it is wholly absurd to postulate a differential maturation as a basis for the observed phenomena of these sex-series. A true reversal of sex has been effected, and the possibilities of its being apparent rather than real have been excluded.

Another line of evidence concerns "developmental energy" of the spring-to-autumn series of eggs of the doves. It has already been mentioned that under the conditions of these experiments the last few eggs of the season are weak, or fail altogether to hatch. These eggs are, however, the largest of the entire season. It will be seen that those germs that *store* most materials are developmentally the weakest germs.

When we measure the length of life of the birds hatched, we find that the smaller eggs of the season, and probably too the smaller eggs of the clutch, give rise to the longest-lived birds. These smaller eggs furnish therefore this additional evidence of greater developmental energy than is possessed by the larger eggs.

Several hundred chemical analyses—each of a single yolk—have shown that the size increase of the eggs is accomplished by actual increase of the various solids of the egg; and that the increase from spring to autumn is gradual; there is nowhere any sudden break or variation. In connection with the analyses it was found that the smaller, spring eggs (male-producers) contain more water than do the larger, fall eggs (female-producers), and a similar relation seems to hold between the smaller and larger eggs of the clutches, as between the larger and smaller of the season. That is to say, the higher water content accompanies the male-producing germ, but the experimental procedures during the season carry all the yolks gradually to a lower level, and then all produce females.

These various facts are taken by Dr. Riddle to mean that the male-producing egg has a higher metabolism than the female-producing egg. If so, anything which increased the metabolism of an egg, which gave it greater vigor, would tend to make it produce a male. Now it is well known that crossing increases the vigor of offspring. Cross-breeding is used by every stock breeder to produce vigorous animals, and even the farmer sows by preference, cross-bred maize, because it yields more sturdy plants; so if we suppose that the amount of vigor is in proportion to the width of the cross, we will understand a possible explanation of the fact cited at the beginning of this paper, that when two *distinct families* of pigeons are crossed a higher metabolism is at once established and the offspring are all males.

Another line of available evidence relates to the variation in weight of the birds themselves at different seasons. It is found that at the season when the female lays the largest eggs, she herself, and also her consort, are smallest in size.

It has further been found that the females hatched from smaller eggs are more masculine in their behavior than females from larger eggs of the same clutch, and that females hatched early in the season are more masculine than their full sisters hatched late in the season.

The conclusion reached from weighing yolks, and from yolk-analyses, is

confirmed by burning yolks in the "bomb calorimeter," and measuring the amount of heat liberated in burning the stored materials. This very accurate method of investigation gives results which confirm the results of breeding, showing that eggs which produce males differ quantitatively from eggs which produce females. The results show too that the storage capacity of the eggs increases gradually during the progress of the season. This storage is highest at the time "developmental energy" is lowest, and both these coincide with the female-producing period.

POST-MORTEM STUDIES

The tenth and last kind of evidence brought from these studies is gained by post-mortem examination of the reproductive glands. Many species of birds, it will be remembered, have normally only one ovary, the right ovary regularly failing to develop, or degenerating rapidly after beginning to develop. This is true of pigeons and doves. But it is found that females hatched under conditions which accentuate the femaleness—for example, late in the season following crowded egg-laying—frequently have the right ovary developed. From this Dr. Riddle concludes that "the same pressure which carries the eggs of spring from male-producing to female-producing levels, also carries the earlier female-producing level to another yet more feminine."

In short, Dr. Riddle thinks, from the many kinds of evidence here outlined, that the nature of sex lies in the nature of differences between *levels of metabolism*, that the two levels are normally associated with different amounts of chromatin, or different chromosome numbers. But he considers these differential amounts or aggregates of chromatin as merely a *means* of insuring two diverse metabolic levels, and thus the two sexes; and he asserts that "if a new metabolic level is forced upon the germ, as in our experiments, the sex of the resulting offspring must coincide with the sex that can develop from this level, and this quite regardless of whether the level was established through a differential chromatin relation or value, or by other means." . . . "Males arise from germs at higher levels, females from the lower."

If it is merely a matter of level, and not a matter, as many have supposed, of some mechanical difference in structure, it is obvious that one might sanely hope to reverse sex. All that would be needed would be to exert sufficient pressure of an appropriate sort. Normally the two different kinds of eggs remain at different levels; one regularly produces males, the other females. To exert the heavy pressure necessary, Dr. Whitman, and later Dr. Riddle, made wide crosses. The pressure thus exerted (speaking metaphorically, of course), is sufficient, while both birds are producing their "strongest germs," to force female-producing eggs to a male-producing level. But when the cross is not of more than generic value, and the birds are made to yield weaker and weaker germs through reproductive overwork, the earlier male-producing level is followed in the weaker germs by a lower female-producing level.

A SKEPTICAL AGE

Every year a number of individuals claim to have controlled or reversed sex. Consequently, the biological world has become decidedly skeptical on the subject. "The insufficiently controlled experiment, the novice and the quack are the trinity of evils that has begotten this widespread skepticism," says Dr. Riddle.

At least one good effect it has had—any experiment which professes to show a control of sex is submitted to an extraordinarily stringent examination. Very few of the experiments stand this test, but there are a few, made by biologists of repute, which seem to have withstood criticism successfully, though in all, or in nearly all of these, it has been impossible to disprove one or another of the possibilities urged by the "chromosomists." Most of these publications have appeared since Dr. Riddle's first short statement[2] in 1911

[2] Paper read December, 1911, before the American Society of Zoologists at Princeton; abstract in *Science*, N.S., Vol. 35, pp. 462–463, March 22, 1912.

of the results with pigeons. These and two or three earlier experimental investigations have been cited in a more recent publication by Dr. Riddle as having a common basis of agreement with his results, and with his theory of the causation of sex.

The German biologist Richard Hertwig and his pupils have succeeded in producing an excess of males from frog's eggs, by allowing these eggs to become "overripe" (take up water) before they were fertilized. Dr. Helen Dean King at the Wistar Institute, Philadelphia, has done just the opposite. By drying toads' eggs before they were fertilized she secured as high as 90% females.

The results agree with those of Dr. Riddle, when it is remembered that he found male-producing pigeon eggs contained more water than did the female-producing eggs. Hertwig increased the water content of frogs' eggs, and produced males; while females were produced when Miss King decreased the water content of toads' eggs.

Sex appears to have been controlled by Whitney in one of the lowest worms, and by Woltereck with a small crustacean. Finally, there are some observations on cattle, and Dr. Alexander Graham Bell's work[3] with sheep, which Dr. Riddle interprets in the light of his own work.

The most notable thing about the studies that have been made on the doves and pigeons, and the thing that distinguishes these studies from practically all others that lead in this direction, is to be found in the systematic attempt to decide, in this most favorable material, whether the sex-control is real or apparent. We have already indicated the results of the inquiry.

SOCIAL APPLICATIONS

The many theories about sex-control in man are usually based on observations in other animals, but as some of the essential facts in man are not known, all attempts at sex-determination at present are futile. But if Dr. Riddle's work withstands the searching examination which it is sure to receive as soon as it is published in full, and if it is agreed that sex is a plastic thing which can be changed by sufficient pressure (again speaking figuratively), then it would appear that sex-control in man is not so impossible as it has sometimes been thought to be in recent years.

Apart from this very obvious application of a knowledge of sex-control in human society, the new idea of the nature of sex opens up some interesting possibilities to the eugenist. If the Whitman-Riddle observations on pigeons should be found substantially to hold good for man, we would be in the way of understanding the existence of so many masculine women and effeminate men in the world—the men and women who make up that "intermediate sex" of which much has been heard lately.

Sex-conservation, perhaps, will be one of the future planks in the eugenics platform. As Dr. Riddle once pointed out, there are in this country probably more masculine women than feebleminded individuals, and more effeminate men than criminals. From a biological point of view, they are usually regarded as undesirable. "At present we look upon the appearance of the inadequately sexed individual as inevitable; just as a generation ago we looked upon the presence of the feebleminded as inevitable. But once we realize that sex—its kind and quantity—can be controlled, we are brought face to face with many new possibilities, and some new responsibilities, in this direction."[4]

If the amount of sex possessed by a man or woman is partly dependent on the influences which surround the individual—on the environment, in short—perhaps we are making a mistake by throwing men and women into environments which are constantly becoming

[3] See the JOURNAL OF HEREDITY, Vol. V, No. 2, pp. 47–57, February, 1914. Some of the other cases are described by T. H. Morgan in his book on Heredity and Sex (New York, 1913).

[4] This and the succeeding quotations are from Dr. Riddle's paper on "The Determination of Sex and Its Experimental Control;" in *Bull. of the American Academy of Medicine*, Vol. XV, No. 5, October, 1914. Some of the material was also published in the *Journal of the Nat. Inst. Soc. Sci.*, Vol. I, No. 1, pp. 39–42; December, 1915.

more similar, and into activities which are growing ever more parallel.

The idea of the biological equality of the two sexes has, in Dr. Riddle's view, been taken altogether too much for granted in modern civilization. "However definitely an equality may exist from social, political or ethical points of view, it is doubtful whether this can be truthfully asserted from any biological standpoint." Man and woman differ in every cell of the body. The differences are numerous, and the whole problem complicated. Those who think they have solved it by laying down a "fundamental equality" of the two sexes may conceivably be considerably disturbed by biological progress in the future.

There is one other outlook which Dr. Riddle thinks his work opens up to the eugenist.

NEW HOPE FOR EUGENICS.

"You well know," he says, "that eugenics in our day lays chief stress upon *heredity*—upon the transmission, intact and unchanged—from parent to offspring of weakness or of strength, of fitness or unfitness, of the manifold characteristics of the organism. And the chief remedy suggested rests upon an elimination of the bearers of weak or unfit germs from the citizenship permitted to leave offspring. And it is of course wholly right that the emphasis now be placed on heredity since it is the ready practical instrument—the one that can be used, and indeed one that the race may never cease to use.

"But is there not a lot of fatalistic philosophy in the conception that mankind's exaltation and power require that mankind eliminate from all share in posterity the base and the weak? Shall man—a maker of environments—when confronted with the problems of his own improvement permanently and sadly turn to the crude and original methods of nature herself?

"At least to those biologists and men of medicine who believe that life-processes are controllable—developmental processes along with the rest—that conception and that remedy will not seem final. To those of us who realize that one characteristic, namely sex, has already been controlled, indicating that *in nature all are controllable* if our industry will but put light where our ignorance now enthrones mystery; to some of us, the production of strength from weakness, of more fit from the less fit, and better from the best, will seem more in keeping with the present general aim of our science, which is to secure control over all life-processes."

Course of Lectures on Eugenics

The Young Men's Christian Association of Washington, D. C., is presenting a public course of free lectures on eugenics under the direction of Paul Popenoe, of the American Genetic Association. The speakers are as follows: March 14, Paul Popenoe, "Prenatal Influences;" March 21, Prof. Roswell H. Johnson, of the University of Pittsburgh, "What Feminism May Do;" March 28, Alexander Johnson, Field Secretary, Committee on Provision for the Feebleminded (Philadelphia), "Bad Breeding in Washington;" April 4, Paul Popenoe, "Laws of Heredity in Man;" April 11, A. E. Hamilton, New York, "What One Baby Did for Race Betterment;" April 18, A. E. Hamilton, "The Gist of Eugenics;" April 25, Dr. Alexander Graham Bell will close the course with an address containing the unpublished results of some of his recent research in heredity. A similar course of lectures was presented last year, with the cooperation of the American Genetic Association, and proved highly successful.

SPOTTED ASSES

An Animal That, Like the Camel and Elephant, Rarely Has Spots—Piebalds More Common in Other Domesticated Animals—Selective Breeding Probably Largely Responsible for This Albinism

ALBERT ERNEST JENKS

Professor of Anthropology, University of Minnesota, Minneapolis, Minn.

FOUR years ago when carrying on investigations of the hereditary spotting of human skin I one day chanced to recall that many individual members of the species of domestic and pet animals and fowls with which I am most familiar at home are spotted with white. The wild members of domestic species and the wild species most nearly akin to our domestic animals are typically or specifically marked. Seldom is this specific marking spotted white. A little time spent in the library showed that the spotting of most of the members of the species of domestic and pet animals is non-specific, and showed that all species of domestic and pet animals spot, except the elephants, camels, and asses (*Equus asinus.*) Further research revealed spotted individuals among the Asian elephants (*Elephas indicus*), and the African camels (*Camelus dromedarius*). Nowhere could I find record of spotted asses.

At that stage of my interest in the question of the spotting of animals and men I made a trip to California and Arizona, and returned *via* New Mexico and Texas. There are many thousands of asses (locally called burros) in those States. I inquired of a score of persons long resident in the southwest, but found no one who recalled ever having seen a burro marked with white spots. I spent eight weeks during January, February, and March, 1914, in Arizona from near the Mexican border to near the central part of the State. No one of whom I inquired had ever noticed a spotted burro. I began to think that the ass should be added to the traditional leopard as a conservative in skin pattern.

March 10, 1914, while driving immediately south of Tucson, Arizona, the burro shown in Fig. 7 was discovered. She was a small fawn-colored jenny with an irregular "blaze" face. She seemed determined to finish her feeding by the roadside, but was finally started toward home. She settled down "at home" in a small woven-wire corral with two other small jennys, one of which had a colt. The burros were in the possession of a group of Mexicans who had recently drifted northward from the State of Sonora, Mexico (a distance of about sixty miles), because of the revolution there. They reported they had brought the spotted burro from near the Mexican border where it had been sired by a jack which "looked just like it." The mother of the blaze-faced animal is light brown with the usual light colored muzzle and belly areas.

March 14, 1914, I passed by train through Charleston, Arizona, where there were three large brown burros feeding near the station. One of them had a blaze-face, and its right fore foot was also white to well above the ankle. The next day near Marfa, Texas, I saw two other white-faced brown burros. After that I felt that there was nothing new under the sun—even in the markings of burros.

IN MEDITERRANEAN LANDS

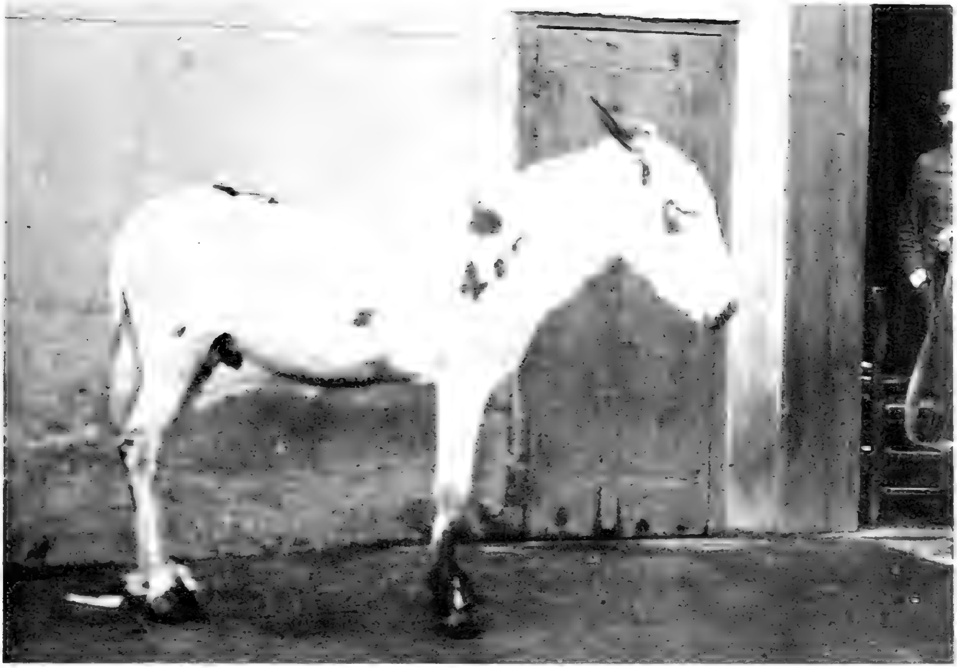
April and May, 1914, were spent in north Africa in Algeria and Tunisia, and in Sicily. In those countries I saw literally thousands of asses or donkeys. There were the usual ones of light fawn color, the browns, the blacks, the ash-grays, and a few which were white[1], but

[1] Lydekker speaks of the Damascus breed of asses as frequently exhibiting white animals. —*The Horse and Its Relatives*, p. 222.

A "BLAZE" FACE BURRO IN ARIZONA

Spotted horses, dogs, cows are common enough, but did you ever see a spotted ass? It is perhaps the rarest of the spotted domesticated animals, except man himself. One of the reasons for this may be that the ass has not been subjected to such severe selection in breeding as have most domesticated animals, and spotting or partial albinism seems to develop under stringent selection, while it is extremely rare in animals living under wild conditions. Photograph by Albert Ernest Jenks. (Fig. 7.)

I neither saw spotted ones nor spoke with men who had noted them. Near the close of May we were in Naples. One day a beautiful, spotted donkey, spirited and high-stepping like a hackney, dashed past me around the corner of Piazza del Plebiscito. He was probably fourteen hands high, and dragged a gentleman's stylish two-wheeled cart with unusual speed and action. He was white, except for dark (brown) ears, a nearly continuous dark dorsal line, and dark spots on the shoulder from four to six inches across. For ten days I kept my eyes open in Naples for that dashing donkey, but I never saw him again. Later, however, I saw three others of the same appearance, though these latter animals were somewhat smaller, and plodded along the roads as donkeys are supposed to travel. One was at Sorrento across the Bay from Naples. He is shown in Fig. 8. One of the other two was on the road from Amalfi to Cava, and the other was in the outskirts of Cava. All four of the spotted donkeys noted in or near Naples were, apparently from their markings, of the same breed. All were white with dark ears, dark dorsal stripe, and a few other dark areas arranged bi-laterally with noticeable symmetry. I was told by the owner of the spotted donkey photographed in Sorrento that his father had obtained it near Naples, probably a short distance to the north, and that in



SPOTTED DONKEY AT SORRENTO, ITALY

The leopard has spots and, according to tradition, does not change them; the ass, on the contrary, has not spots and appears very reluctant to acquire them. But here is an Italian specimen which is mostly spot, the original dark color being reduced to a few patches. His facial expression lends some support to a theory that has been advanced—that albinism is due to a lack of vigor. Photograph by Albert Ernest Jenks. (Fig. 8.)

that vicinity there were others of the same appearance.

It has seemed worth while to call attention to these two types of asses, the "blaze" face, and the white with bi-lateral dark areas, because it appears that asses spot much less frequently than other domestic animals, with the exception of the elephant and the camel.

SPOTTING AND DOMESTICATION

So far as I am able to learn there are few exceptions to the rule that the members of wild species are typically or specifically marked. There appears to be no exception to the rule that in domestication all have yielded individuals which are spotted with white. To what is this due? Is the seemingly more frequent spotting of domestic animals (including human) due to an upsetting of the normal process of pigment metabolism in the conditions of domestication? Is the seemingly more frequent spotting of domestic animals due to the protection in domestication which saves the spotted individuals from the destructive selective forces which prey upon the animals of a natural (or "wild") environment? No matter which one of these conditions is the cause of the frequent spotting of domestic animals, and granting that both may have contributed, selection in breeding or forced interbreeding, or both, have probably greatly aided production of spotted domestic animals.

Selection by man has saved the spotted animals (even perfecting breeds with well-fixed spotted pattern), while clothing has saved the spotted man by making selection against spotted individuals more largely impossible. My colleague, Dr. C. E. Johnson, Department of Animal Biology, University of Min-

nesota, calls my attention to the fact that the ass, camel, and elephant have been the subjects of selective breeding to a relatively low degree as compared with most of the other domestic animals. The number of "breeds" among them is very small. This fact lays strong emphasis on selective breeding as the important factor in the spotting of domestic animals. However, we have the cases of spotted humans which are certainly not due to selective breeding. In the case of the human I am obliged to believe that domestication with its frequent large demands on nervous energy plays an important part in the production of the albinotic spottings of the skin.[2]

[2] Short bibliography of piebald humans:

1. Hutchinson, Sir Jonathan, "On Paleogenetic Face-pattern in Acroteric Piebalds," pp. 1479–1481 of *The British Medical Journal*, vol. I, June 18, 1910.
2. Simpson, Q. I. (with W. E. Castle), "A Family of Spotted Negroes," pp. 50–56 of *American Naturalist*, January, 1913.
3. Pearson, Karl, (with E. Nettleship, C. H. Usher, and B. C. Lamb), *A Monograph on Albinism in Man, Atlas, Part 2*, (London, 1913.)
4. Stannus, Dr. Hugh, "Anomalies of Pigmentation Among Natives of Nyasaland; A Contribution to the Study of Albinism," pp. 333–365 of *Biometrika*, October, 1913.
5. Jenks, Albert Ernest, "A Piebald Family of White Americans," pp. 221–237 of *American Anthropologist* (N.S.), vol. XVI, No. 2, April-June, 1914.
6. Cockayne, E. A., M.D., "A Piebald Family," pp. 197–200 of *Biometrika*, November, 1914.

Bad Eyes and Bad Hearts

As the latest theory of heredity assumes that every inherited factor in the germ-plasm affects not one but many parts of the body, interest in searching for these parallel effects, these "correlated variations," is increased. J. Strebel finds an association between certain hereditary forms of eye-defect (ektopia, myopia) and a weak heart, and reports the discovery in the Archiv für Rassen- und Gesellschafts-Biologie (X, 4). Evidence is not sufficient to show how close the relation between the two facts is, or whether indeed it is really a matter of heredity, rather than of chance association. It should be easy to collect further cases to determine whether these hereditary defects of the eye are regularly accompanied by defects of the heart.

War Hurts Scientific Breeding Abroad

Intelligent live-stock breeding is going by the board in France and Germany, and production "regardless of consequences" is being insisted upon, according to the *Agricultural Gazette of Canada* (p. 206, March, 1916). The exportation of cows is said to have been prohibited and orders given that all cows must be bred, no matter whether in accordance with a scientific plan of herd- and breed-improvement. "This means," says the *Gazette*, "that the education of a century will be partly undone abroad, and a breed of worse than grades—mongrels— is likely to be created that will have to be regenerated." Probably the result will be that Europe will have a much smaller amount of purebred stock for export after the war, than before, and American breeders will therefore be thrown more upon their own resources.

WHY CHILDREN RUN AWAY

Nomadism a Racial Trait, Inherited in Connection with Sex—Evidence from the Lower Animals and from Children—A Study of the Inheritance of Temperament

Review of a book by CHARLES B. DAVENPORT

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WHEN a child runs away, the mother usually ascribes its truancy to mere "naughtiness," or bad companions, or maybe original sin.

But the child's motive, according to Dr. Charles B. Davenport,[1] is the same as that which makes its parents visit Europe, or its Uncle John start off on a fishing trip. The causes ascribed for these various actions are usually quite different from the real cause, which is the primitive racial instinct to wander—an instinct so deep-seated that it is found in lower animals as well as in man.

We all have it, presumably; but some of us have it so hedged around by conventionalities, and the habits of civilized society, that we never really feel the call of the wild, or the blind impulse to start off somewhere—no matter where. Others are so impelled by this instinct that only lock and key can keep them in one place.

"It is a familiar observation," Dr. Davenport begins, "that persons differ greatly in their capacity for remaining quiet and satisfied for a long period in one place. One occasionally meets a woman who, though living within 30 miles of a metropolis, has, in the 80 years of her life, been there only once. At the other extreme are the tramps and gypsies who travel constantly or with only slight intermissions, and many of whom have repeatedly visited all quarters of the globe." On the other hand, there are those who do not travel constantly but who, leading a settled life, occasionally are impelled to jump over the traces, to run away, sometimes in a trance or dazed condition.

In short, the impulse to break camp and "hit the trail" is a very widespread one. Dr. Davenport describes all its forms by one name—nomadism, and drives the point home by quoting James Russell Lowell: "The American is nomadic in religion, in ideas, in morals, and leaves his faith and opinions with as much indifference as the house in which he lives."

Most of us Americans will probably be disposed to plead guilty to nomadism, of the literal kind, at least. Our ancestors must have had a certain amount of it, or we would not be here. Americans probably represent a selection of the more nomadic individuals of Europe, and it is no shock to learn that we are all at heart nomadic. A tendency to wander is indeed characteristic of primitive man and most animals. It is one of the traits, Dr. Davenport says, which sharply sets us off from most plants—although the botanist might tell a different story.

But look at our poor relations, the anthropoid apes—they seldom sleep twice in the same place. Or take the birds—the migratory habits of some species are notable. Others, on the contrary, are permanent residents of a place, seldom traveling more than a few miles, particularly if they are ground birds on a small island.

This difference in the migratory habits of birds suggests to Dr. Daven-

[1] The Feebly Inhibited: Nomadism, or the wandering impulse, with special reference to heredity; Inheritance of temperament. Pp. 158, price $1.50. Washington, D. C. Published by the Carnegie Institution, 1915.

port that nomadism is not a matter of social influences or of reading travel advertisements. "Whether a species tends to travel far or tends to stay near its home depends upon its constitutional factors—its instincts. The differences between men in respect to these points are as truly specific as the differences between swallows and grouse, and are as truly due to differences in inherited instincts."

But, it will be objected, the strength of the wandering instinct in a man varies. Once I wanted to join the Navy in order to "see the world;" then I stayed twenty years on the same job, quite contented. This alleged instinct of nomadism therefore cannot be really a constitutional trait, or it would not be subject to such fluctuations.

On the contrary, Dr. Davenport answers, we find that even the birds do not migrate all the time—only twice a year. We would expect the instinct to show itself only periodically. And we have other good evidence that there really is an inherited trait of nomadism.

We have already mentioned that the great apes have this instinct; and the basal instincts of these animals are the same as those of man. Then consider the primitive peoples and their migratory habits. If we look around the world we are driven to conclude that a wandering tendency—an absence of fixed abode—is widespread over the globe. "Indeed, it might be said that fixity of abode is a relatively recent acquisition, as yet only found in certain peoples in which the sedentary habit is highly developed; and that, consequently, it is not to be wondered at if even in a non-nomadic people like most of the Chinese, the French, or the Swiss, the racial trait of nomadism should persist in certain families, or after having been eliminated, have crept in again."

The extraordinarily common tendency to run away which children show, as every mother knows to her sorrow, is another bit of evidence proving that nomadism is really an inborn trait. The early life of the child, it is assumed, repeats the early life of the race; therefore it is no surprise to us that children, "true to their function of revealing the past, sometimes almost as soon as they have acquired the upright habit of locomotion, as if intoxicated by 'out-of-doors,' start off and, by some inner impulse, go on and on with no idea of where or why, tempted by an open gate or by the instinct to follow a man or a vehicle, or as a just-hatched chick follows any moving thing."[2]

ADOLESCENT RUNAWAYS

There is one more place where we must look for evidence. At the adolescent period the instincts are more highly developed than at any other time of life. If there is any widespread instinct of nomadism, it ought to show itself then. So it does. Kline, who collected 501 cases of runaways, found the greatest number of them occurred at the age of 15 years, and plenty more at 13 or 14.

From such evidence, Dr. Davenport feels justified in concluding that nomadism is a racial trait, a matter of heredity. In modern America, which has lured to itself the restless and those in whom love of ancestral home is weak, we naturally expect to find many families showing the nomadic trait; and he has collected the histories of 100 of these families, embracing 616 individuals, on which he bases the present study.

A glance over the array of cases shows immediately that most of the nomads are males. That is exactly what the reader would expect, no doubt. Not only is it easier for a man than a woman to ride the brake-beams, not only is it easier for a man than a woman to roam through a life of vagrancy and avoid arrest, not only is man's courage of the kind which faces more readily the dangers and inconveniences of such a life; but, one would say, the nature of the male sex is such, and the nature of the female sex is such, that we would expect a life of nomadism to be more congenial to a man than a woman. Man is the active, restless, energetic, aggressive animal; woman is the contrary. We express the same idea in very superior language, nowadays, by saying that

[2] Quoted by Davenport from G. Stanley Hall, Adolescence, Vol. II, p. 376; New York, 1904.

woman is relatively more anabolic and man katabolic. Whatever words one uses, the facts are indisputable; historically woman's place is in the home (we use the words without any political implication) and man's rôle is that of the hunter and fighter.

Under such conditions it is no surprise to us to find that there are more male than female nomads in Dr. Davenport's tables. If nomadism is really an instinct, we are quite prepared to find it associated with sex—a sex-limited trait. Nomadism might be considered as much a sex-limited trait as is a mustache.

But Dr. Davenport does not adopt this obvious explanation, apparently[3] because there *are* a good many women nomads. Disregarding the fact that even women have some hair on the face, and some women have a great deal, he thinks that nomadism cannot be a sex-limited trait, since we find so many women displaying it.

Now there are, it will be recalled, two ways in which an inherited character can be associated with sex. First, it may be sex-limited; that is, it may be due to the secretions of the male sex-glands. Second, it may be sex-linked, that means according to current theories, that the factor for this trait "just happened" to get in the same chromosome with the factor which determines sex. So sex and a sex-linked character have to go together, but they are not due to the same cause, nor is one the cause of the other; their association is merely a coincidence.

Evidently, nomadism is associated in some way with sex. As Dr. Davenport has ruled out the first and most obvious explanation—that it is sex-limited, he has only one other possibility[4] to explain the greater number of affected males. It must be a sex-linked trait, like color-blindness.

TEST OF THE HYPOTHESIS

Fortunately, it is easy to test the correctness of this hypothesis. Without going at length into the theory of sex-linkage, we may say that it demands at least one simple result in the present case: if Davenport's explanation is right, then matings where the father is nomadic and the mother neither nomadic nor of a nomadic family, must result in no nomadic offspring whatever. The boys cannot be nomads because they cannot inherit a sex-linked trait from their father, but only from their mother. As neither the mother, nor her family, in this case had it, she cannot transmit it to them. The girls cannot be nomadic in either case. In families where the father is a nomad and the mother stays at home supporting the children by taking in washing, or something of the sort, the children must all have a perfectly domestic disposition, according to Davenport's hypothesis; they will not run the streets at nights, or steal rides on freight cars, or go to sea, or take to the road, or do anything else that nomads do and well-ordered children do not.

We turn to Davenport's table 5, which lists the matings of this critical kind. It lists thirty-two boys and eighteen girls. Instead of no nomad boys and no nomad girls, of this number, we find sixteen nomad boys and five nomad girls.

The hypothesis does not hold good, and although Dr. Davenport makes an attempt to explain the discrepancy in several legitimate ways, the difference seems to the reviewer to be too big to

[3] Against the hypothesis that nomadism is essentially a male characteristic is, he says, "the fact that nomadism is by no means confined to the male sex; in certain matings, daughters as well as sons are nomadic. The distribution of the nomadic trait among the offspring is, then, a function of a particular type of mating." The critical mating to test this hypothesis would be that in which both parents are nomadic. All the children from such a mating, girls and boys alike, should be nomadic. But Davenport's table of matings of this type contains only four families. No sound conclusion can be drawn from such a small number; but even there, it is worth noting that he gets one non-nomadic child, where his hypothesis requires that there should be none whatever.

[4] That is, only one other possibility in heredity. Of course, it may be said that the difference is one of training, girls being kept at home with mother while boys are turned out to roam the streets with "the gang." Probably this is a real factor in bringing about a larger number of nomadic men than women, but Dr. Davenport does not discuss it.

be overlooked, particularly as similar difficulties are found in the tables of some of the other types of matings.

That nomadism is hereditary, Dr. Davenport's study goes far to prove. That it is hereditary as a sex-linked character, the study does not prove. Moreover, many of the facts cited by Dr. Davenport—for example, that the nomadic instinct fails late in life, just as the sexual instinct does—indicate that it is really a sex-limited rather than a sex-linked character; that its association with sex is not wholly a matter of accident, as he assumes that it is.

If there is anyone who has not answered to his own satisfaction the question Why Girls Leave Home, we can at least give him a clue. It is because they inherit some of the qualities properly belonging to their more unstable, restless and nomadic brothers.

INHERITANCE OF TEMPERAMENT

Following his study of nomadism, Dr. Davenport undertakes an analysis of the distribution in families of temperament or its expression in *mood*. This is a problem of great fundamental importance, and it is a pleasure to note that eugenists are showing a tendency nowadays to attack such problems, instead of concentrating all their attention on degenerate conditions or trivial traits of no concern to the race.

We all recognize a certain average of normal temperament, says the writer, and we also recognize that this may change to an increased activity and elated emotional tone, on the one hand, or to a decreased activity and lower emotional tone on the other. He embraces all moods in these two divisions: the "hyperkinetic state" is that marked by one or all of the following elements: destructiveness, exaltation, homicidal acts and threats, irritability, psychomotor excitement, and violence. The "hypokinetic state" is on the whole the opposite of this, marked by anxiousness, worry, fear, slow movement, and so on. Finally, there is often an alternation of these two states.

The existence of these two contrasted moods, and the fact that an individual often passes from the one to the other, will be recognized by every one. But an examination of family histories shows that in some families there is a prevailing tendency for the one condition, in other families for the other. Dr. Davenport undertakes the task of bringing under one general scheme the inheritance of these various types of mood, and evolves the following hypothesis:

> There is in the germplasm a factor, *E*, which induces the more or less periodic occurrence of an excited condition (or an exceptionally strong reactibility to exciting presentations) and its absence, *e*, which results in an absence of extreme excitability. There are also the factor, *C*, which makes for normal cheerfulness of mood, and its absence, *c*, which permits a more or less periodic depression. Moreover, these factors behave as though in different chromosomes, so that they are inherited independently of each other and may occur in any combination.

This hypothesis is tested on eighty-nine families, embracing 629 progeny, many discrepancies are ascribed to "imperfect dominance," and in conclusion Dr. Davenport says "it is morally certain" that the hypothesis is correct.

Even though the confession of a doubt be tantamount to a confession of immorality, the reviewer cannot accept the conclusion with as much confidence as Dr. Davenport does. It seems to him that the whole analysis of moods is open to attack from the psychologists, and that the formula used to explain the heredity would explain almost anything. In other words, the reviewer cannot help feeling that Dr. Davenport has made the case much simpler than it really is.

He presents data on the inheritance of temperament in twins and the inheritance of the suicidal impulse. Even though it may eventually be found that his analysis of the inheritance of mood is not exhaustive, he must be given credit for having attacked an interesting, complicated, and important problem, and for having shown that in our daily behavior, where the power of heredity would perhaps be little suspected, our reactions are largely due to the hereditary nature of our temperaments.

FINDING THE PREPOTENT SIRE

Only One in a Thousand, in the Guernsey Breed of Cattle, Is Likely to Bring Marked Improvement to the Breed—Advanced Register the Only Way of Discovering Him

J. M. Hover
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THE superiority of one parent or breed in determining the characteristics of its offspring is termed *prepotency*. The fact that marked prepotency occurs in only a few animals in every breed makes it an important consideration in animal breeding. Indeed, nearly all of the so-called families in the various breeds, and in fact some of the breeds, owe their origin to a male or female ancestor which was strongly prepotent in features recognizable and useful to man.

While prepotency is generally thought of in connection with some useful character, it is not necessarily an advantageous thing. It is conceivable that an animal could be prepotent in a way diametrically opposite to the end sought by the breeder. In such a case the sooner the breeder recognizes and eliminates such an animal from his herd the more quickly will the desired results be obtained. In using the term here, however, we shall have in mind only prepotency in the production of butterfat.

Inasmuch as the dairy industry must rest upon an economic foundation, and since heavy production of milk and butterfat is the basic factor in profitable dairying, it is just as important, and perhaps more important, that the sires of "boarders" be eliminated in cattle breeding as it is to eliminate the "boarders" themselves. This can best be accomplished by the development of methods for the recognition of the prepotent animals and strains in production in the various breeds and the general use of these, both in grading and in building up purebred herds. The following study of the Guernsey breed was made with the idea of discovering, if possible, those animals and strains which have had, and are likely in the future to wield, the largest influence on the breed so far as higher production is concerned.[1]

Prepotent animals are usually discovered through the performance of their offspring, sometimes long after they themselves have died or perhaps been slaughtered in the prime of their breeding career. Probably discovery of prepotent animals will constitute an essential feature of breeding in the future, but the advanced register, if utilized properly, will eliminate in a large measure much of the chance attendant upon breeding and impressive sires may be selected with a certainty heretofore impossible. There are, without a doubt, in the untested stock of the country many great producing sires and dams, but the progressive breeder will scarcely take the risk of selecting sires from these, especially when they are not related closely to a tested strain of proven merit.

INDIVIDUAL PREPOTENCY

There are doubtless many ways in which the data of the advanced register might be used to discover those animals which have been most powerful in influencing the high production of the breed. The common method is to regard the number of advanced registry offspring as the test. This is open to the following criticisms: (1) Some of the greatest animals may be used in

[1] The data for this paper were secured from the Herd Register and Guernsey Breeders' Journals of the American Guernsey Cattle Club.

small herds and therefore have relatively few get, whereas an inferior animal may be used in a large herd and have relatively many get. (2) The advanced registry standard is so low that with judicious feeding and care almost any animal can make the advanced registry requirements. Indeed, at the present time the average requirement for the advanced register is practically 125 pounds below the average performance of the cows in the advanced register. This relation of different classes as compared with requirements is indicated in the following table:

AVERAGE PRODUCTION COMPARED WITH ADVANCED REGISTRY REQUIREMENTS

Class	*Age*	*Average Fat Record*	*Average A. R. Requirements*
A	5 up	490.4	360.000
B	4½–5	480.3	350.875
C	4–4½	457.4	332.625
D	3½–4	439.9	314.375
E	3–3½	411.8	295.125
F	2½–3	400.1	276.875
G	2–2½	377.3	259.625
	Average	436.74	312.771

anything like conclusive results. Most of the older sires would be entirely excluded from such a list. When the advanced register is older, this method of study would be more feasible than at present.

At the present time what seems the best method is to set a higher hypothetical standard of excellence for the offspring and judge the great sires by this. There is no practical reason for applying a similar test to the dams because these will be discovered through the achievements of their male ancestors or male descent. Indeed, if a prepotent dam does not have a prepotent son or perhaps grandson, her influence on the breed as a whole becomes practically negligible, however superior an animal she herself may be. This is due, of course, to the relatively large number of progeny of the male as compared with the female.

It appears from the table that the number of advanced registry cows which a certain sire has may therefore more properly be considered an indication of opportunity, prolificacy, or business expediency, than a test of prepotency in production, since a breeder in the habit of testing would place more daughters of his herd sires in the advanced register than one who did not, and a prolific bull in a large herd which is being regularly tested, may have an exceptionally large number of daughters in the advanced register without really being a sire of great producers. It is probably true, however, that when one daughter of a sire makes an unusually large record, his other daughters attract attention and are therefore tested, and in such cases the number of advanced register daughters might bear some relation to his merit.

Another method of studying prepotency in any breed, which would seem to be very promising, would be to compare the daughters of various sires with their dams, and note the extent of increase. Here, however we find the data far too limited to give

In setting a higher standard we choose to select 600 pounds of butterfat produced by a mature cow as the basis for a discriminatory study. We select 600 pounds as a standard because it may be safely assumed that any cow making such a record possesses individual excellence as a producer; for it is exceedingly doubtful whether such a record could be made from an ordinary cow through any artifice of feeding and milking. Using the same scale of increase (which appears to be substantially correct) as is now used in the advanced register, the 600 pounds standard for the different ages would be as indicated in the table on page 175.

From that table it may easily be seen that 490.5 pounds of butterfat for a 2-year-old cow is considered a 600-pound record, since such a cow could in all probability make such a record

ADVANCE REGISTRY REQUIREMENTS AND 600 POUNDS STANDARD

Class	*Regular Requirement*	600 *pounds Standard*
A	360.00	600.00
B	341.75—360.00	581.75—600.00
C	323.50—341.75	563.50—581.75
D	305.25—323.50	545.25—563.50
E	285.00—305.25	527.00—545.25
F	268.75—285.00	508.75—527.00
G	250.50—268.75	490.50—508.75

upon re-entry when mature. In computing "the mature cow equivalent" for any cow it will be found simplest to subtract the individual entrance requirement for the cow in question, and add this to the actual record made. Thus, a certain cow at 2 years of age made 606 pounds of butterfat. The entrance requirement at this age is 250.5 pounds of butterfat. Now, according to above formula, we have $(360-250.5)+606=715.5$ pounds, or the theoretical production of this cow at 5 years and above.

If a certain sire happens to produce a single daughter with a 600-pound record, we do not have in this alone adequate proof of his breeding capacity. This may be due to the dam, or, perhaps, a fortuitous variation. If, however, he produces three or more such daughters, the suggestion of individual prepotency becomes very strong. With this thought in mind we have, in the table at the botton of this page, listed all sires which have produced three or more daughters with records the equivalent of 600 pounds.

From the table it will readily be seen that we have up to December, 1915, only thirty-two sires which have produced three or more "equivalent of 600 pounds" daughters. There may be many others which were capable of such a

ALL SIRES HAVING AT LEAST THREE "EQUIVALENT OF 600 POUNDS" DAUGHTERS

	Reg. No.	*Birth Date*	*No. of A. R. Daughters*	*No. of "600 lb." Daughters*
Imp. King of the May	9001	1903	17	14
Imp. May Rose King	8336	1901	24	12
Golden Noble II	1836	1905	23	11
Imp. Masher's Sequel	11462	1900	64	9
Imp. Gov. I of the Chene	10563	1904	21	9
Imp. Lord Mar	14359	1903	24	7
Imp. Galaxy's Sequel	16904	1904	38	6
Rinaldo	8917	1903	11	5
Stranford's Glenwood of Pinehurst	13609	1906	12	4
Beda's May King	11893	1907	5	4
Dolly Dimple's May King of L	12997	1907	5	4
Charmante's Rose King	11746	1906	8	4
King Masher	11084	1906	7	4
Jewel's Independence	10324	1905	9	4
Jethro Bass	11366	1906	8	4
Triple Champion	13067	1907	12	4
Ledyard Bay	11074	1905	10	4
Imp. Golden Secret of Lilyvale	10028	1904	10	4
Justinee's Sequel of the Preel	2119	....	17	4
Lavanton	11611	1905	5	3
Imp. Coras Gov. of Chilmark	8971	1903	28	3
Glenwood's Main Stay 16th	9384	1903	9	3
Glenwood's Reputation	7687	1901	15	3
Glenwoods's Stranford	9386	1903	15	3
Buckthorn	4781	1896	11	3
Masher	63	1904	27	3
Imp. Holden IV	12179	1906	5	3
Fernwood of Homestead	7448	1901	9	3
Guydette	3966	1894	5	3
Starlight's Excelsior	7992	1902	23	3
Glenwood Boy of Haddon	4605	1895	36	3
Imp. The Conqueror II	15323	1905	13	3

record but do not have it because (1) some were used in small or grade herds and had little opportunity; (2) some are still too young to have many of their offspring tested; (3) some were too old at the time the advanced registry system was inaugurated; (4) many breeders do not test, hence records of daughters are unknown; (5) some breeders secure better and some poorer records as a result of different methods of feeding, etc. However, it seems certain that, regardless of the fact that a few worthy sires might perchance be excluded for the above and other reasons, we do have here 32 proven sires whose offspring have increased and may be depended upon in the future to increase the average production of the breed.

Up to December, 1915, there was a total of 254 sires who had produced one or more "equivalent of 600-pound" daughters. In other words, 32 sires, or only 12.6% of the total number of sires of 600 pound daughters, have three or more such daughters. This indicates that sires of great producing cows are relatively few in number.

There were up to December, 1915, 417 cows having records the equivalent of 600 pounds. The 32 sires listed above, produced 156 of these 417 cows. Therefore, we note that 12.6% of the sires of "600-pound" cows produced 37.4% of those cows.

Restating these facts in tabular form, we have the following data:

222 sires produced 261 "equivalent of 600-pound" daughters, or 1.17 each.

32 sires produced 156 "equivalent of 600-pound" daughters, or 4.87 each.

Thus, the 32 sires above, were more than four times as prepotent as the remaining 222 sires of "600-pound" cows.

When we observe that these 32 sires are only .092% of the male animals registered in the American Guernsey Herd Books and 2.20% of the 1,454 sires of advanced register cows, the tremendous importance of the few strong sires, from the standpoint of improving the production of the breed, becomes quite apparent. Indeed, it can be safely assumed from the above facts that less than one out of every thousand of the registered male animals will have a marked tendency to lift the production of the breed above the 600 pound level.

STRAIN OR FAMILY PREPOTENCY

What has been said above refers more particularly to individual prepotency or the tendency of a sire to get producing daughters. It is clear that a knowledge of the prepotent strains can only be gained by a study of the ancestry and descent of our great producing animals. When we study the pedigrees of the thirty-two sires in the above list, a noteworthy fact presents itself, namely, that they may nearly all be placed in a few groups according as they trace directly to some notable ancestor.

These groups are as follows:

GROUP A

Related to May Rose II 8648 E. G. H. B.

- Charmante's Rose King.
- Golden Noble II.
- Imp. King of the May.
- Imp. May Rose King.
- Imp. Golden Secret of Lilyvale.
- Jethro Bass.
- Dolly Dimple's May King of Langwater.
- Lavaton.
- Beda's May King.

GROUP B

Related to Masher R. G. A. S. 705 P. S.

- Imp. Masher's Sequel.
- Justinee's Sequel of the Preel.
- Imp. Galaxy's Sequel.
- Triple Champion
- King Masher.
- Charmante's Rose King.
- Imp. Cora's Governor of Chilmark.

GROUP C

Related to Governor of the Chene R. G. A. S. 1297 P. S.

- Imp. Governor I of the Chene.
- Imp. Holden IV.
- Imp. Cora's Governor of Chilmark.
- King Masher.
- Imp. The Conqueror II.

GROUP D

Related to Imp. Glenwood Girl 1693

- Glenwood Main Stay 16th.
- Glenwood Stranford.
- Glenwood Reputation.
- Glenwood Boy of Haddon.
- Stranford's Glenwood of Pinehurst.

GROUP E

Related to Sheet Anchor 2934
- Ledyard Bay.
- Charmante's Rose King.
- Triple Champion.
- Glenwood's Reputation.
- Glenwood's Main Stay 16th.
- Beda's May King.

GROUP F

Related to Imp. Sir Champion 58
- Guydette.
- Rinaldo.
- Buckthorn.

GROUP G

Related to Imp. Fernwood Lily 1468
- Starlight's Excelsior.
- Fernwood of Homestead.

GROUP H

Miscellaneous
- Imp. Lord Mar.
- Jewell's Independence.
- Masher 63.

It is readily apparent that in the larger groups above we have the most important representatives of what may properly be regarded as the Guernsey *families*. Thus we have the "May Roses," the "Mashers," the "Governor of the Chenes," the "Glenwoods," and the "Sheet Anchors." Groups F and G, while perhaps not commonly recognized as families, if we judge from the animals listed and others that may soon have three "600-pound" daughters, may properly be so regarded. The miscellaneous sires might be regarded as representing potential families requiring only the intelligent and consecutive effort of breeders to establish them.

Breeders must depend upon intelligent selection for whatever breed improvement is to take place in the future. Intelligent selection presupposes on the part of the breeder: (1) An appreciation of individuality as related to performance and other desirable characters; (2) a knowledge of ancestry in relation to breeding capacity for performance, prolificacy, constitutional vigor, etc. It follows, therefore, that a knowledge of the prepotent strains in the various breeds, whether it be for performance, prolificacy, constitutional vigor or other characters, becomes an invaluable aid in selection.

There are three systems of breeding represented in the ancestry of the above listed sires, viz., outcrossing, inbreeding, and line breeding. From these pedigrees it would be difficult to adduce sufficient evidence to prove the superiority of any one system. Group F offers a good illustration of a strain probably made prepotent by close breeding, *i. e.*, line and inbreeding. The dam of Guydette was an inbred cow. Rinaldo is the son of Guydette from a closely related dam. The May Roses have also been in and line bred to a very considerable extent. Theoretically close breeding by rendering character more pure, ought to give a more prepotent strain, and this theory seems to hold true in practice for a number of notable sires. However, it must be observed that some of the best sires in the breed are outcrosses between several of the leading families as instanced in the case of Charmante's Rose King.

The Guernsey, in common with all pure bred cattle, is prepotent over the ordinary stock of the country. This is an important asset to the progressive farmer because he can, by the utilization of good purebred sires, render his herd in a few years nearly, if not in fact, the producing equivalent of a purebred herd. The writer has observed a large number of calves by Guernsey sires, born to very ordinary cows of mixed breeding and in nearly every case the offspring showed very definitely the outstanding Guernsey characters.

The greatest value of the advanced register comes through its revelation of great producing cows and sires of the breed, and, through them, of the producing strains. It thus aids in the only way man probably has for permanently improving the breed, *i.e.*, by selection in breeding. There are, however, some weaknesses in the system. In the first place, the best cows are repeatedly retested for still higher records. Since the test period is twelve months, the period between consecutive calving is prolonged to such an extent as materially to decrease the offspring of the best cows. Furthermore, the rich feeding to which such cows are subjected probably interferes with the reproduc-

tive function with the same result. These are weaknesses which might be overcome to a large extent (1) by making the test period the same as the gestation period, (2) by establishing a herd ideal in breeding rather than an individual cow ideal, *i.e.*, by breeding for a "500-pound or 600-pound equivalent" herd rather than a 1200-pound cow. By stating records of young cows in terms of mature cow equivalents, a uniform herd standard can be established without the necessity for so much retesting which probably often obscures the real value of a cow as a breeding animal by involving the element of training in production.

CONCLUSIONS

By way of summarization it may be said:

(1) Marked prepotency is limited to a comparatively few animals;

(2) Strongly prepotent sires usually belong to prepotent families or strains;

(3) Prepotency is probably enhanced by inbreeding;

(4) Prepotency may become a valuable aid to intelligent selection in breeding for greater production.

Heredity and Juvenile Delinquency

The view of Dr. William Healy, director of the Juvenile Psychopathic Institute of Chicago, that heredity is only a minor factor in juvenile delinquency, is not shared by Dr. W. J. Hickson of the psychopathic laboratory of the municipal court in Chicago. In a recent interview, Dr. Hickson said: "After all these opportunities of learning and checking up, and the efforts of men of science to spread the information, we still see many people who would solve the delinquent boy problem by trying to 'change the leopard's spots' by environmental means.

"If the boy is normal, environment has little or no influence on him.

"Thanks to the laws of heredity, some of our greatest men have attained eminence despite the slums in which they were born and raised.

"The normal boy will take care of himself in any environment. That playgrounds, social centers and the like are good for him, no one will deny. That they are essential is not true, because normality means adaptability.

"These social agencies do not reach the defective, and cannot."

Dr. Hickson concludes that most juvenile delinquency is due to mental defect, the greatest cause of which is heredity. A campaign for "negative eugenics" would therefore be desirable.

Sale of Canadian Cattalos

The Canadian government has purchased twenty cattalos (hybrids between the American bison and domestic cow) from the estate of the late Mossom M. Boyd, of Bobcaygeon, Ontario, whose breeding experiment was described in the JOURNAL OF HEREDITY for May, 1915. Sixteen cows and four bulls made up the herd purchased, which was sent to Scott, Sask. The Boyd estate retained thirteen, three of which have been killed. The remaining ten will be bred in a continuation of the experiment, which aims to transfer to the domestic (Polled Angus) cattle the valuable hump and fur of the buffalo. The government herd will be bred along similar lines.

THE PITANGA

A Valuable Fruit of Brazil Which Deserves to be More Widely Cultivated — Successful in Florida and California— Methods of Propagation

A. D. SHAMEL
Physiologist, U. S. Department of Agriculture, and

WILSON POPENOE
Agricultural Explorer, U. S. Department of Agriculture

"IT IS said," writes Padre Tavares, "that the pitanga dropped from the hands of Nature, while she was at play one day, and became at once a charm to the eye and a delight to the palate. Each fruit is a glowing ruby, suspended by a delicate stem amidst the cool, green leaves of the pitanga tree, a chalienge alike to the covetous eyes of children and of birds; nor can the decrepit old man, bowed down with the weight of years, escape its attractions, for he seats himself beneath its shade to meditate upon the Eternity which is approaching. Surely, Brazil does not have to envy Europe her cherry trees, bending in May under the weight of their ruby fruits; our pitangas surpass them both in beauty and in taste."

These lines from one of the ablest of living Brazilian naturalists testify to the esteem in which the pitanga is held throughout those parts of Brazil in which it is found, and indicate something of the beauty of this fruit—rare as yet in most other tropical and subtropical countries, but worthy of extensive cultivation.

During our visit to Brazil in 1913-14, made primarily for the purpose of studying the Navel orange in its native home, Bahia, we were particularly impressed with the value of two native fruits which were found abundantly in the coastal cities. One of these, the jaboticaba, was described in the July, 1914, issue of the JOURNAL OF HEREDITY. The other, which is the subject of this article, is better known outside of Brazil than the jaboticaba, but its cultivation is by no means so extensive as we believe its value warrants.

Following a stay in Rio de Janeiro, our expedition, consisting of P. H. Dorsett and the writers, moved to Bahia for the purpose of making a detailed study of the Bahian Navel orange, the parent variety of the Washington Navel. The results of this study have been described by the senior author in the JOURNAL OF HEREDITY for July, 1915. Of the many interesting plants found in connection with the culture of the Navel orange at Bahia, few were so conspicuous and none so interesting as the pitanga, *Eugenia uniflora* L., of the Myrtle family. Many of the roadways in Cabulla and other Navel orange districts of Bahia were found to be bordered on either side with beautiful and well kept hedges of this plant, as were the driveways or walks leading to the residences of many orange growers, which are usually set back some distance from the road. Frequently pitanga trees are grouped near the houses, furnishing an abundant supply of fruit for home use. The general cultivation of this plant among the orange groves of Bahia, both as an ornamental and for fruit production, suggested its possible use for similar purposes in the orange growing districts and warmer portions of the United States.

DESCRIPTION

The pitanga, as usually seen, is a broad, compact shrub, but occasionally it forms a slender trunk and becomes a small tree up to 30 or 35 feet high. Its foliage is deep green

A TROPICAL RIVAL OF THE CHERRY

Cherries fail to grow well in the tropics, but Brazil has a fruit which might largely take their place. This is the pitanga, a member of the Myrtle family, whose beautiful red berries possess an aromatic pungency almost unknown in the fruits of cooler climates. Photograph of fruit grown at Miami, Fla., natural size. (Fig. 9.)

and glossy, the new growth of a rich wine-color. The flowers, which are about half an inch broad, have four white petals, with a tuft of stamens in the center, and are delightfully fragrant. They are produced singly on slender stems about an inch long, and are followed by bright crimson fruits, of the shape of a small tomato, deeply ribbed, about an inch in diameter, with a thin skin and melting, juicy flesh of aromatic, spicy flavor, comparable to none of the temperate fruits but somewhat resembling other members of the Myrtaceae. The single large seed, about the size of a cherry stone, lies in the center of the fruit and is easily removed.

Technically, the species may be described as follows:

An arborescent shrub or small tree, commonly branching close to the ground, broad, compact, sometimes developing a trunk 1 to 2 m. in height, with an erect, rather broad crown. In Brazil it often attains a height of 6 or 8 m.; in Florida it does not usually exceed 4 or 5 m. Branchlets thin and somewhat wiry, glabrous. Bark light brown, very smooth.

Leaves subsessile, opposite, entire, reddish when young, emitting a pungent odor when crushed, the blades ovate, shortly acuminate at the apex, rounded to subcordate at the base, 3–5 cm. long, 2–3 cm. broad, glabrous, finely pellucid-punctate, deep green above, paler beneath, midrib slightly impressed above, midrib and the rather few transverse veins slightly raised below, the transverse veins uniting toward the margin; petiole not over 3 mm. long, slender, grooved above.

Flowers white, fragrant, solitary upon slender glabrous peduncles 1½–2½ cm. long in the axils of the leaves. Calyx tube cylindrical, the lobes pale green, oblong, concave, rounded at the tips, 4 mm. in length, ciliate, reflexed. Petals 4, oblong-obovate, concave, 8 mm. long, 4 mm. broad, ciliate. Stamens numerous, erect in a large cluster, the filaments 4-6 mm. long, white, filiform, the anthers oval, pale yellow. Style slightly longer than the stamens, filiform, the stigma simple. Ovary quadrilocular.

Fruit a berry, one or sometimes two-seeded, depressed-globose, 2–3 cm. in diameter, prominently eight-ribbed longitudinally, deep crimson, shining, crowned by the persistent green calyx lobes, the disk small, sunken. Epicarp thin, membranous; mesocarp soft, juicy, crimson, of pungent, subacid flavor. Seeds spherical when 1, hemispherical when 2, commonly under 1 cm. in diameter; seed coat membranous.

While generally known as *Eugenia uniflora* L., it has one or two synonyms which are occasionally seen. Chief among these is *E. Michelii* Lam., a name which was used in this country until a few years ago and is still commonly applied by some foreign writers. Nurserymen in Florida and California have sent out numbers of plants under this name. *Stenocalyx Michelii* Berg was used by Barbosa Rodrigues, one of the best known Brazilian botanists, and following him other Brazilian writers have used it. *Myrtus brasiliana* L. is an obsolete name occasionally seen in old works, while *Plinia rubra* L. and *Plinia pedunculata* L. are also listed in the synonymy of the species. Piso and Marcgrav called it *Ibipitanga*.

DISTRIBUTION

The pitanga is indigenous in Brazil, extending over a wide area. Tavares[1] states that it is found in the states of Rio de Janeiro, Paraná, Santa Catharina, and Rio Grande do Sul, where it grows along the banks of water courses and rivers, and in the edges of the forest. It is common in cultivation throughout many other sections of the country. It is interesting to note that Thomas Green,[2] in 1823, listed the pitanga as a "native of Goa in the East Indies." Goa is a small Portuguese colony on the western coast of the Indian peninsula, and during the early days of Portuguese colonization there was an interchange of economic plants between this colony and the Portuguese possessions in America, resulting in the cashew (*Anacardium occidentale* L.), the guava (*Psidium guajava* L.), and other American plants becoming thoroughly established in India, while the mango, the carambola (*Averrhoa carambola* L.), the jak (*Artocarpus integrifolia* L.), and other oriental fruits were transferred to Brazil. Quite probably the pitanga was carried to Goa along with other Brazilian plants, and Green took it to be indigenous. Many of the citrous fruits which were established in Brazil by the Portuguese may also have come from Goa by way of Portugal.

The name pitanga, by which this fruit seems universally to be known in Brazil, is undoubtedly of Tupí origin. The Tupí Indians inhabited a large part of Brazil at the time of the discovery, and the names which they gave to many indigenous plants have persisted to the present day, though their meanings have in many cases become obscure. Martius[3] states that pitanga

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[1] Tavares, Prof. J. S., "As Fruteiras do Brazil," in *Broteria*, Vol. X, fasc. V, Braga, 1912.

[2] "Universal Herbal," Vol. I, London.

[3] Beiträge zur Ethnographie und Sprachenkunde Amerikas zumal Brasiliens, Vol. II, Leipsig, 1867.

is derived from the Tupí verb *piter*, to drink, and *anga*, odor or scent; one may assume, therefore, that the name was given in reference to the characteristically aromatic juice of the fruit.

In other countries the culture of the pitanga is generally very limited. No references to its culture at Goa have been found in recent literature, but we may presume that it is still grown in that region. It is cultivated in northern India at the botanic garden of Saharanpur, and is offered in the catalog of this institution under the name of "Brazil Cherry," but the statement is made that it does not fruit abundantly in that climate. It is grown in Ceylon, where, according to Macmillan, it is called Goraka-Jambo. Tavares states that it is cultivated in China, but we can find no other authority for this. It seems quite probable that it may have been introduced in the Portuguese colony of Macao, near Canton, where the climate would probably be very favorable to its growth. It is said by Wilder, who calls it the "French Cherry," to be a common garden plant in Hawaii. In French it is generally called cerise de Cayenne, or Cayenne-cherry; Dr. Trabut[4] states that it would rapidly become popular in Algeria if it produced more abundantly, having been found to be quite hardy along the coast. Emile Sauvaigo,[5] another French writer, states that it is the commonest tropical fruit cultivated in the vicinity of Algiers; he gives it the common name of cerise carrée as well as that applied by Trabut. In Cuba it is occasionally seen in gardens, and is called cereza de Cayena. In the United States its culture is limited to Florida and California, but it is grown very successfully in both these regions. In 1887 P. W. Reasoner[6] wrote, "The tree is quite frequently met with in Orange County and middle Florida, and is gaining in favor as a fruitbearing plant." At the present time it is common in gardens along the East coast, especially in the vicinity of Miami, where the fruit has recently commenced to appear in the market, and on the West coast from Fort Myers northward. After the plants have attained the requisite age they fruit abundantly, often producing two crops a year.

In California the pitanga has never become so common as in Florida. It is, in fact, rare in California gardens, and undoubtedly worthy of much more extensive cultivation. Dr. Franceschi[7] reported that it was growing in Montecito in 1895. In recent years quite a few plants have been disseminated by nurserymen in California. In the United States the name Surinam-cherry is much more common than pitanga, and is, in fact, the one generally used.

HABITS OF GROWTH

At Bahia, Brazil, the pitanga was found much more commonly as a hedge plant than in any other form, but such plants produce much less fruit than those allowed to develop naturally. The largest trees seen in Bahia, at the Roça Coronel in the suburb of Roma, were about 15 feet high, with trunks six inches in diameter. At Agua Comprida, near Bahia, on the ranch of Col. João de Teive e Argollo, we found a magnificent specimen nearly 35 feet high, with a trunk 15 inches in diameter. These trees, in December, which is one of the spring months in Bahia, were loaded with their bright red fruits. Considerable variation was noted on different trees, in regard to quantity, shape, size and color of fruit. Dr. V. A. Argollo Ferrão, to whom we are indebted for invaluable assistance during our stay in Bahia, stated that he had frequently observed this variability of individual trees, and suggested the possibility of improving the pitanga by careful selection of seeds. Bud selection would not be practicable at present, since seed propagation is the only method generally employed in Brazil. By planting seeds from trees

[4] In *Revue Horticole de l'Algerie*, XII, p. 161, 1908.

[5] Les Cultures sur le Littoral de la Mediterranee, p. 207, Paris, 1913.

[6] Report on the Condition of Tropical and Semi-tropical Fruits in the United States in 1887, p. 25, Washington, 1891.

[7] *Santa Barbara Exotic Flora*, p. 33. Santa Barbara, Cal., 1895.

PITANGA HEDGES ALONG THE ROADWAY

This scene near Bahia, Brazil, shows one of the best uses of the pitanga—to form a hedge. But it is not limited to this use, for it makes a shapely tree, and bears even more heavily, when planted alone. In northern climates, it might be used as a pot plant, and produce its strikingly beautiful berries indoors. It is remarkable for the great speed with which it develops its fruit, which in the tropics is sometimes ripe within three weeks from the appearance of flowers. (Fig. 10.)

which bear abundantly, and whose fruits are of good size and quality, marked improvement could probably be secured. This has recently been illustrated in California with the feijoa (*Feijoa sellowiana* Berg), a plant belonging to the same family; seeds from selected fruits have produced much better results than those taken without regard to parentage.

Two varieties have been offered by Reasoner Brothers of Florida; one the ordinary crimson-fruited pitanga, and the other "black-fruited," being considerably darker in color than the common type. Tavares mentions two

varieties which occur in Brazil, but states that they appear equally good to him. There are so many variations among seedlings that it would undoubtedly be an easy matter to distinguish a number of horticultural varieties; it would be less easy, however, to insure their coming true from seed. When some readily applicable means of vegetative propagation has been found, more attention can profitably be given to this subject. Fortunately, there appears to be less variation among seedlings than occurs among many tree fruits which have been subjected to long cultivation, the pitanga being comparable in this respect to its near relative the strawberry guava (*Psidium cattleianum* Sabine.)

THE FRUIT AND ITS USES

Bahian pitangas were found usually to be slightly less than an inch in diameter, flattened, deeply ribbed, and commonly containing one seed with a thin, gray seed-coat which becomes papery when dry and is easily removed. The size of the seed varies greatly in fruits from the same tree and is not always the same in proportion to the size of the fruit. Several large fruits were found which had comparatively small seeds and a large amount of soft, juicy, spicy pulp.

Miss Thompson[8], who has recently made an analysis of pitanga fruits in Hawaii, finds that they contain a total of 9.30% solids, of which 1.93% are insoluble. The percentage of acids is 1.44, of protein 1.019, and the total percentage of sugars 6.06. Fat is present in about .6%.

The uses of the fruit are numerous. As a fresh fruit, when fully ripe, they are delicious, though sometimes the novice finds their strongly aromatic, almost pungent flavor peculiar and even disagreeable. The jelly which is made from them possesses a character all its own, and vies with guava jelly in popularity among Bahians. It impressed us as being a product of unusual merit. Pitanga sherbet is an especial favorite in Bahia, and is regularly served in all the cafés. It is of a beautiful deep salmon color, and delicious in flavor. A liquer is sometimes prepared from the fruit, and also syrups and wines which are considered by the Brazilians to have medicinal value, being stomachic and facilitating digestion.

Aside from the fruit itself, the foliage is extensively utilized by the Bahians, being highly esteemed for decorative purposes. In the notes made by one of the writers on Christmas Day, 1913, the following paragraph appears:

> "The people use pitanga branches to decorate carts, animals, street cars, and houses. The leaves are scattered over the floors of the living rooms in the houses, and when crushed under foot give off a delightful, refreshing, pungent aroma."

The use of this plant for decorative purposes at Christmas time is probably more extensive in Bahia than is the use of holly in the eastern United States; it seemed to be, in fact, the most popular decorative plant of the region. During the holiday season bunches of pitanga branches were offered for sale by vendors on almost every street.

In the United States, the fruit is usually eaten while fresh or is made into jelly. Pitanga sherbet should be tried by all who can obtain the fruits, however, and other uses will doubtless present themselves as the fruit becomes better known in this country.

THE CROP

A remarkable thing about the pitanga is the short time which elapses between the appearance of the flowers and the ripening of the fruits. Tavares assures us that the fruits are ripe within three weeks from the time of flowering, and in Florida, where the climate is not so tropical, they ripen within five or six weeks. In Brazil the plants bloom in September and ripen a small crop in October, flowering again for the main crop about December or January. In Florida the main crop is produced in March, with a few late fruits extending the season until May or June, and sometimes a second crop late in summer. In California the season is September or October.

[8] "The Composition of Hawaiian Fruits and Nuts," in the Report of the Hawaii Agrl. Exp. Sta., 1914.

The plants are said by Bahians to fruit regularly, one grower estimating the number of fruits produced by an individual bush at 5,000, or sometimes more. In Florida they appear to fruit very regularly and abundantly, after they have attained sufficient age. Apparently it requires several years for the plants to come into full bearing, as they are of rather slow growth. It has frequently been reported in California that the plants do not fruit well. Probably this is due in many cases to lack of sufficient age, since old plants at both Santa Barbara and Orange have borne good crops. During the first four or five years little fruit seems to be produced.

PROPAGATION AND CULTURE

Thomas Green gave the following directions for germinating the seeds: "Set the stones fresh from their places of natural growth in small pots filled with light earth, plunge them into a hot-bed, observing to keep the earth moist, but not wet. In about six weeks the plants will appear; when about 4 inches high, separate them very carefully, plant each in a small pot, plunge them into a hot-bed again, and carefully shade them until they have taken root. Treat them in the same way as other tender plants from the same countries, keeping them plunged in the tan-bed, and watering them sparingly in winter."

These directions have been followed by one of the writers at Riverside, Cal., and have given very satisfactory results. The seeds usually germinate well, if planted while fresh; at Reasoner Brothers' nurseries, Oneco, Fla., they are allowed to remain on the ground under the tree until they germinate, when the young plants are taken up and potted. It can thus be seen that there is no difficulty in starting the seeds, and they transplant readily.

Tavares states that the plant prefers a light, sandy soil. It grows well in south Florida on shallow, calcareous soils, and almost equally well in California on sandy loam. Unless trained, the plants usually assume a bushy, compact form, and branch close to the ground. They require no unusual care and seem to be fairly drought resistant, though coming from a moist region. The amount of frost which they will stand when young is not great, but they have passed successfully through temperatures of 27° or 28° above zero F., and when they have attained three or fours years' growth they should stand even lower temperatures without any injury whatever.

Genetics at Washington Experiment Station

The studies of inheritance at the Washington State Agricultural Experiment Station have been conducted with wheat, oats, barley and rye. The investigations with wheat include the qualitative characters and smut resistance. The inheritance of such specific characters as beards, head length and grain color, and the general characters of drought resistance, milling quality and stiffness of straw are among those which are being investigated. Many of the specific characters have been found to behave in a manner that can be definitely predicted when certain varieties are crossed. The inheritance of some of the more general characters remains to be determined.

The difference in the resistance of different varieties of wheat to smut has been determined. Various crosses are being made for the purpose of producing more valuable varieties with a less tendency to smut.

The studies with oats include the inheritance of panicle type, glume color, hullessness, etc. Similar studies are being made with barley. In the work with rye attempts are being made to obtain a variety without beards. Three generations or four crop seasons are necessary to determine the inheritance of specific characters of unknown value.

WAR, SCIENCE, CIVILIZATION

Biologist Protests Against the Kind of Biology Preached by Militarists—Defective Politics Resting on Defective Understanding of Nature Makes War Now Possible—Changes in Public Sentiment That Will Make War Unlikely—What the United States Could Do

Review of a book by William E. Ritter
Director of the Scripps Institution for Biological Research of the University of California, La Jolla, Cal.

THE idea of settling by arbitration the question as to whether a hungry man may take a loaf of which he has the full strength to possess himself is chimerical and quixotic.

So says a recent German writer, attempting to justify wars of expansion. Taking this statement as a starting point, Professor William E. Ritter, of the University of California, has undertaken[1] to show what modern biology would say about war of that type.

In the first place, he strongly objects to the tendency of militaristic writers to justify wars among men on the mere ground of a struggle for survival among the lower animals. Admitting the truth of the statement made in the first paragraph of this review, he remarks that it does not cover the whole case.

"Such situations constitute what militarists of the Homer Lea and von Bernhardi type regard as the biological necessity for war. As a biologist, I would insist that the argument which would make war everlastingly necessary on such grounds implies a limitation to the conception of 'biological' that is utterly inadmissible by biology itself. Biology never stops and never can stop in its dealings with any animal by regarding it just as an animal in an unrestrained sense. It always deals with some particular *kind* or *species* of animal. The fish must be treated as a fish, and the bird as a bird. Neither can be disposed of by merely attending to such general attributes as need for food and propagation, common to both, and to all animals.

"In exactly the same way is it impossible for biology to consider man as just an animal. If it touches him at all it must touch him as the *human* animal. Confusion of thought in this matter, not only among laymen but among many biologists, is amazing, and has led to the most bizarre speculations about man, some of these being truly direful in their effects on human outlook and conduct."

If biology, then, is to be drawn into the discussion of war, it must insist that man be considered as distinctly a human animal, endowed with reason, and foresight, and inventive talent, and humane sentiments.

Given these endowments, man dehumanizes himself if he does not use them to forestall situations that would make hunger press so severely on him as to lead him to war. This is a question of the proper distribution of the earth's resources.

THE HEART OF THE PROBLEM

"This brings us to the kernel of this discussion, and, as it seems to the writer, to the supreme question our nation will have to grapple with if it would accomplish anything significant toward world peace. That question is, Can we present any practical plan whereby nations foremost in the march of civilization shall be assured such

[1] War, Science and Civilization, by William E. Ritter. Pp. 125; price, $1 net. Boston, Sherman French & Co., 1915.

portions of the primal resources of nature as are necessary to enable them to maintain the places they have won, without having to resort to war to secure them?"

"Stating the matter still more pointedly, is an international arrangement possible whereby a nation might under certain circumstances give over to other nations portions of its territory or other economic advantages peacefully, deliberately, and without immediate and definite compensation? The suggestion even in the form of a question will probably seem too absurd to merit a moment's thought by practical men. My own categorical answer to the question is, no, as long as politics, national and international, rest on a philosophy of nature and human nature so defective as that on which they now do rest; but yes, if political practice could be based on a philosophy that should conform to the actual facts of nature and human nature."

Politics can never be scientific, Dr. Ritter thinks, because it is devoted to the meeting of exigencies, the dealing with matters of expediency, which are quite alien to the spirit of science. But if politics can not be a science in a strict sense, yet it cannot measure up to the real needs of modern civilization, unless it rests on a foundation a large part of which is science.

An essential part of this foundation would be the recognition of those general principles of nature and human nature upon which man, the human animal, would base his efforts to ward off in effective fashion crises of national want, and thereby avoid being placed in the position of the hungry man who takes by force the loaf of bread.

WAR DEFEATS OWN END

From this point of view, it is of first importance to recognize that war defeats its own end. It is anomalous that a system of distributing the necessities of men's existence among the political divisions of the earth, should be in vogue whereby in order that men may get that which they must have, they are obliged to destroy a large portion of that for which they are striving. Those who defend war as a means of gaining territory or other economic advantage, and refer to the biological struggle for existence as a justification, forget the nature of the sub-human struggle. That results in the destruction or defeat of some of the combatants merely; while the struggle among human beings, especially those living under civilization, results in destroying not only some of the combatants, but much of the goods over which they fight. From this standpoint, so-called civilized warfare is far less scientific than the pillaging warfare among savages, which aims chiefly at capturing and carrying off the goods for which it is waged.

Further, when politics invokes the support of biology to justify war, it must recognize that "Nature's resources are actually limited for partly civilized man, but potentially unlimited for fully civilized man." So far as nature and science are concerned, there is ample reason to believe that civilization might ensure its own progress indefinitely, even though "pressure of population upon means of subsistence" be accepted as an inevitable concomitant of that progress. But an essential condition of continued progress would be the utilization of all the resources of nature to the fullest extent.

In the way of doing this stands the stupendous obstacle of existing political ideas and practices relative to the ownership of its primal resources. "It seems unescapable that if science is to be enabled to do its best for civilization, some way will have to be found to overcome this difficulty. Nothing could be further from scientific than the way Africa and the Pacific islands are being allotted among the civilized nations. Perhaps there is little hope of early reaching a rational basis in this matter. Surely there would be none were it not for the fact that civilized men are ruled so largely by general theories held in the blindest way; but that these theories may undergo profound change when personal interests are seen to be at stake; and that, on the whole, right theories appeal more to normal men than wrong ones."

All of the combatants in the present world war believe that they are fighting for the cause of civilization; but they do not define what they mean by civilization, and it is doubtful whether they really know. To the author, Civilization "is the one-word designation of the grade of evolution for one organic species, *Homo sapiens*, in respect to those attributes which set it off most sharply from all other species. It *is* evolution, though only a part of it, albeit an overwhelmingly important part."

Now civilization in this sense, the author goes on to show, is incompatible with great empire. "More disastrously fallacious reasoning was never carried on than that according to which a nation's status in civilization is dependent upon its territorial and economic extent. . . . The reasoning that would justify strife for unlimited possessions just for the sake of having them, would be paralleled by reasoning that because the individual cannot live without food, therefore he should try to eat all the food in sight."

The nation which wishes to achieve a high degree of civilization, then, cannot spend its energy squabbling over boundary lines, but must devote itself to developing civilizing processes. It must recognize that science furnishes the groundwork for a great rational faith in man's capacity for indefinite progress. It must recognize that the phenomena of cooperation, coordination or, as the author prefers to say, integration, are just as much a part of evolution as are the phenomena of differentiation, which we usually have in mind when we think of evolution. The militarists who are seeking shelter behind biology commonly ignore this, and speak of a "right of conquest" as something sacred, because it has existed in the past.

"Such arguing is intolerable to a consistent evolutionist. In the use made of the doctrine by political leaders, diplomatists, and militarists, the utmost contradictoriness and confusion prevail. On the one hand they borrow from biology and use with the greatest assurance such vague phrases as 'struggle for existence' and 'survival of the fittest,' while on the other hand they seem quite oblivious to the essential idea of forward movement and growing interdependence among men, the very essence of progress in civilization."

"From the standpoint of biological evolution, progress in civilization may be characterized as the differentiation and intensification of love and intellect, and of the intellectualizing of love and the affectionizing of intellect."

A CHANGE IN POLITICS

Now the author inquires, if such a view of human nature were generally adopted, as being based on scientific grounds, and if man should at the same time get "the mighty faith that there is practically no limit to nature's capacity for yielding to man all those things which, from sources outside himself, he truly needs," what would be the psychological result? What would be the effect on the attitude and conduct of men toward one another and toward nature?

On the negative side, it would banish the dread of the "tragedy of population," which has been present ever since Malthus created it.

On the positive side, it would imbue productive effort with a religious zeal. The tasks of conserving, developing, distributing, and wisely using the forces of nature, would be viewed in a truer light. Men would really gain a religious feeling, which would direct them in subjugating nature, rather than in subjugating men and nations.

"It remains to ask what our nation might do at this time to forward this great end. Manifestly we cannot escape playing some part in the grim world-drama now being staged. The answer may be short and sharp. Two sorts of things may be done; indeed, must be done, if the part we play is to be positive and honorable. One sort will pertain to the nation itself; the other to its relations with other nations."

The first thing to do is to "subject ourselves to a self-examination the like of which we have hitherto known little about." It will result in the increase and improvement of our education,

culture, and the pursuit of art and science.

The second is to put into practice the principles which underlie civilization, by showing other governments that we are willing to help them get what they need for their own greatest development. As a hypothetical case, Dr. Ritter suggests that we might turn over to Japan some of our non-contiguous possessions, in order that her congested population may have room to breathe.

"The possibility of conditions in which the policy of England would be to help Russia to better seaports, if Russia truly needs them; of France to help Germany to more and better room in Africa for colonization, if Germany's needs in that direction are clear; and of Germany to help Japan, the United States, and Great Britain to free the whole Pacific from need of extensive armaments, might be counted on to fill millions of persons the world over . . . with an enthusiasm that would be irresistible and permanent because sustained by reason as well as by emotion.

"This is idealism, but it is scientific idealism."

The "Practical Eugenic Movement"

The "Practical Eugenic Movement," an organization directed by T. W. Shannon, of Delaware, Ohio, has more than 7,250 members, according to a recent letter from Professor Shannon. It publishes a monthly magazine called *Practical Eugenics*, which is said to have more than 4,000 circulation. The movement and organ are devoted largely to euthenics, emphasizing such factors as sex hygiene, temperance, care of the baby, personal hygiene and a war on tobacco, and a widespread propaganda is carried on through lectures.

New Publication on Genetics

The first issue of *Genetics*, a bimonthly periodical record of investigations bearing on heredity and variation, appeared at the end of February. It contains as frontispiece a hitherto unpublished portrait of Gregor Mendel, and the following papers: "Non-disjunction as proof of the chromosome theory of heredity," by Calvin B. Bridges; "The numerical results of diverse systems of breeding," by H. S. Jennings; and "Hereditary anchylosis of the proximal phalangeal joints (symphalangism)," by Harvey Cushing. *Genetics* is edited by a board, of which Prof. George H. Shull, of Princeton is the chief, and is published by the Princeton University Press. It is announced that it starts with about 270 subscribers, who pay $6.00 each per year.

Rare Publications on Genetics Available

Through early members, the American Genetic Association has come into possession of several complete sets of the Proceedings and magazine of the American Breeders' Association, and the volumes of the JOURNAL OF HEREDITY previous to the present year. These entire sets of the Association's publications are offered for sale as wholes, and the secretary will be glad to correspond with any one interested in securing a collection of these publications.

DEPARTMENT OF GENETICS AT ILLINOIS COLLEGE OF AGRICULTURE

The Division of Genetics in the College of Agriculture at the University of Illinois has recently been removed to its new building. The building is 142 feet long and 42 feet wide, and contains two animal rooms, a storeroom, a graduate laboratory, class room, seminar room, and two offices. The work in Genetics was begun by Dean E. Davenport many years ago and has grown steadily since. Four years ago Dr. J. A. Detlefsen took charge of the courses and investigations. The College of Agriculture at the University of Illinois was among the first of the Agricultural Colleges to recognize the importance of Genetics to the curriculum of well-trained agricultural students. An elementary course in Genetics has an enrollment of 300 students; an advanced course enrolls about fifty seniors and graduate students. Research upon small laboratory mammals is in progress. Numerous species crosses in lettuce have been studied. A study of the transmission of mutations in the skunk has been carried through the first cross-bred generation. Four distinct types of mutants have been obtained, at least two of which promise a new and valuable type of skunk fur. (Fig. 11.)

THE STRAWBERRY, A TRIUMPH OF PLANT BREEDING

IF one asks, "What has deliberate, systematic plant breeding accomplished in horticulture during recent years?" no general answer can be given. In some fruits scientific plant breeding is still almost unknown. The varieties of cherry, for example, which are grown in the United States are practically all of unknown origin; they appear by accident and some one recognizes their merit and propagates them. In other fruits much more has been done by scientific breeding, but probably with no single fruit has more been accomplished than with the strawberry.

Of the 200,000 acres or thereabouts which are planted to strawberries in the United States, it is probable that 90% are planted to varieties which have been produced during the last quarter of a century, as the result, not of chance, but of intelligent manipulation by breeders.

Strawberries have been grown in this country ever since it was first settled, but the original strains bore fruit only in the early summer. One of the greatest advances in the industry was the introduction of the fall-bearing or ever-bearing varieties, the first of which was Pan-American, produced by Samuel Cooper, of Delevan, N. Y., in 1898. This was a sport from the variety Bismarck, which bore only in the early summer.

Mr. Cooper produced a number of seedlings by self-fertilization from this sport, and then crossed them with each other and back on the parent. In this way a number of other more desirable varieties were obtained.

Crossing Pan-American with Dunlap (Senator Dunlap), a widespread and famous variety, Harlow Rockhill, of Conrad, Iowa, produced in 1908 the variety Progressive, which has proved one of the most popular in the northern States. The number of plants of Progressive in existence at the present time cannot be much short of 700,000,000 or 800,000,000—a pretty good record for eight years.

Dunlap itself, which has long been the most widely grown northern variety, originated with Rev. J. R. Reasoner, of Urbana, Ill., in 1890, but was not introduced to the trade until 1900. It was the result of definite breeding.

The variety Klondike, which makes up probably nine-tenths of the area planted in the southern States, was produced as long ago as 1895 by Robert Cloud, of Louisiana, as a result of a carefully planned cross.

Why, it may be asked, has intelligent plant breeding been so much more widespread with the strawberry than with any other fruit? The ease with which results are got appears to be the principal reason. Crosses are easily made, seedlings are easily grown, and they multiply so rapidly by runners that a large stock can be obtained in a very short time. Thus a commercial breeder, if he can produce something really good and keep it under his control for a few years, is able to offer for sale a large enough stock to bring generous financial returns. This seems to be the principal reason why the strawberry grower can get varieties produced with a view to meeting his definite needs, while the grower of many another fruit is forced to content himself with varieties that appeared by accident, and may be far from ideal.

Encouraging Race Suicide

"Some day," says the March *Eugenical News*, "it may be regarded as a crime against society to publish such an advertisement as the following which has been running in the *Survey*: 'Wanted — Married couples without children, between the ages of 30 and 45, to take charge of cottages' at a school for boys." But not if they prefer caretakers of inferior quality.

The

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FOUR BABY GIRLS AT ONCE

These quadruplet daughters were born to Mr. and Mrs. F. M. Keys, Hollis, Okla., on July 4, 1915, and were seven months old when the photograph was taken. Their weights at birth were as follows (reading from left to right): Roberta, four pounds; Mona, four and one-half pounds; Mary, four and one-quarter pounds; Leota, three and three-quarter pounds. In the latter part of February, Roberta weighed sixteen pounds, and each of the others weighed sixteen and one-quarter; they have never had any other nourishment than their mother's milk. Their aunt vouches for the fact that the care of the four is less trouble than a single baby often makes. The mother has had no previous plural births, although she has borne four children prior to these. Her own mother had but two children, a son and daughter, and there is no record of twins on the mother's side. The father of the quadruplets is one of twelve children, among whom is one pair of twins. In so far, therefore, as heredity is a cause, it is possible that the appearance of these quadruplets is due to the influence of the father, not the mother. Such a supposition requires that the girls should all have come from one ovum. The question of the part which heredity plays in plural births is not yet cleared up, and its study may throw light on other problems of heredity. In this case note the uniform shape of the mouth, and the ears, set unusually low on the head. Photograph copyrighted. (Frontispiece.)

IS TWINNING HEREDITARY?

Problem Much More Complicated Than It Appears at First Sight Two Kinds of Twins Possible Influence of the Father—The Frequency of Multiple Births

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THE layman is often impatient with the indefinite character of much of our eugenic information. It is not easy for him to understand the difficulties that attend an investigation into the heredity of what may seem to be a single clear cut characteristic. For this reason it may be of interest to point out a few of the obstacles met in such a study. The question of a possible hereditary tendency for twin production may be selected for this purpose. The problems encountered are not identical with those that would be met in the investigation of the heredity of some other characteristic but they are in a measure similar and will serve to furnish a typical example.

The occasional occurrence of twins among the offspring of man and other animals that usually produce only one offspring at a time, has always been a matter of interest to both the popular and the scientific mind. This interest is due not so much to the fact that these mammals may sometimes produce two or more young at a birth as to the extreme similarity that frequently exists between the young thus produced. The causes that result in twin production, however, are not fully understood, and still less is known of the rôle heredity plays in this connection.

If one attempts to learn more about the heredity of twinning he is forced to consider a number of subsidiary questions which are in themselves of considerable interest. It is the main purpose of this paper to call attention to the bearing of some of these secondary considerations in relation to the question of an hereditary tendency toward twin production. Incidentally a few fragmentary data from family histories are also presented, but the writer is still collecting this material[1] and has little hope that it will be in shape for final publication for some time.

THE ORIGIN OF TWINS

One of the first questions to be raised at the beginning of an investigation into the existence or non-existence of any hereditary tendency is: What is the exact nature of the characteristic in which this tendency is to be sought? It might seem that nothing could present less difficulty in this connection than twinning. But such is far from being the case.

In the first place, it may be recalled, embryologists hold that twins arise in two very different ways. In one case, two separate egg cells, from the same ovary or from opposite ovaries, are fertilized each by a separate sperm cell. The resulting embryos develop independently like the different members of an ordinary litter. They need have no greater resemblance to each other than brothers and sisters born at different times, and the chance that they will be of like sex is the same as for any two consecutive children in the same family. Such twins are variously designated as *fraternal*, *heterologous*, *biovular*. There seems to be ample evidence that many pairs are of this sort.

In the case of the other class of twins, it is claimed that both members of the pair are derived from a single egg that has been fertilized by a single sperm. At some time subsequent to fertilization two centers of growth appear in the

[1] The writer of this paper will welcome family histories in which several pairs of twins occur, or other data bearing on the question of hereditary twinning.

DO THESE GIRLS LOOK ALIKE TO YOU?

These triplets from St. Louis illustrate one of the difficult problems that confronts the student of hereditary twinning. Triplets, it is believed, may be derived from one, two or three egg cells. In which class do these three girls belong? People who see them for the first time usually consider them very similar. Their eyes, hair and complexions are practically indistinguishable to ordinary observation. They are the youngest of thirteen children, and their hair is darker than that of any of their brothers or sisters. Yet it will be seen that their features are by no means identical, although more similar than one would expect if they really represent three distinct ova. The doctor who attended their birth says they had each a complete and separate set of foetal membranes. There are no other cases of twins or triplets known in this family, or among the immediate relatives in Germany. (Fig. 1.)

embryonic cell-mass and from each of these centers a distinct individual develops. Such twins, known as *identical, homologous*, or *uniovular*, are always of the same sex and, moreover, often show the most striking similarity.[2] The evidence in favor of the existence of this type of twins is drawn from many sources and seems quite conclusive.[3]

It will be apparent from the foregoing that there are at least two fundamentally different classes of twins which must be taken into account in a study of heredity. Biovular twins, since they owe their existence to the simultaneous ovulation of two ova instead of one, must be explained entirely by reference to some attribute of the mother and could not possibly be due to any characteristic of the father. Uniovular twins, on the other hand, might conceivably be due to factors supplied by either the father or the mother or, like a recessive character, to some inherent peculiarity in the germ cells of both parents. In one case the characteristic is manifested in the parental generation (mother), in the other it appears in the filial generation (twins themselves). This is an obvious and important distinction. Indeed it might be argued that the occurrence of uniovular and biovular twins represents two entirely distinct and unrelated phenomena. Yet this point is frequently neglected in studying twins from a statistical or hereditary standpoint.

Simon Newcomb's memoir[4] "A statistical Inquiry into the Probability of Causes of the Production of Sex in Human Offspring," may be mentioned as one illustration of such an oversight. In this article it is shown from very extensive data that twins are of the same sex much more frequently than can be explained by reference to the laws of chance. Even so careful a student as Professor Newcomb, proceeding from this fact and completely ignoring the possibility of the existence of these two types of twins, tried to prove that the sex of twins, and therefore all embryos, is determined subsequent to fertilization. If, however, the current views as outlines above are correct it follows that, while the data presented by Newcomb are exactly what would be expected, his arguments from them are practically pointless.

THE TWO KINDS OF TWINS

Since embryologists insist that students of heredity recognize the existence of these two classes of twins, the next question that arises is as to how they may be distinguished. It is commonly assumed that twins of opposite sex are necessarily biovular, while those of similar sex may belong in either class. It therefore becomes a question of passing judgment on the degree of resemblance between the members of each pair where the sex is the same. This is no easy matter. On the one hand biovular twins may sometimes closely resemble each other as is shown by the fact that two brothers or sisters born several years apart are frequently very similar. That uniovular twins, on the other hand, may be very different is strikingly indicated by those cases in which one of the individuals has suffered from some handicap before birth, or is reduced to a mere parasite attached to its more vigorous partner. Identity is rarely attained.

The relation of the foetal membranes in which the twins develop has been proposed as a criterion, and it is probably true that any pair of twins which at birth are found to be surrounded by a single set of membranes have come from a single ovum. But it does not necessarily follow that those surrounded by separate sets of membranes are biovular.[5] That they frequently are not

[2] The extent of this similarity, which may reach even to the finger prints, has been studied by Professor Wilder and others: see H. H. Wilder in the *American Journal of Anatomy*, vol. i.

[3] The following observations may be mentioned: (a) in some lower forms it is possible experimentally to cause two embryos to develop from one egg; (b) in the case of the North American Armadillo, it is definitely established that *four* young regularly develop from each egg; (c) embryos showing all grades of division from a slight bifurcation to complete separation of individuals are actually found.

[4] Carnegie Institute of Washington Publication No. 33.

[5] This is the present view of Sobotta and others, but such data as are referred to in the text seem to throw some doubt upon it.

PLURAL BIRTHS ARE NOT AN UNMIXED BLESSING

"The stork is one bird that does not go South with the millionaires in winter, but remains up North conscientiously on the job," says Charles Hopper, of 1620 Race Street, Cincinnati, Ohio. Thus Hopper, in announcing the birth of triplets, announces at the same time a cheerful outlook on life. His three latest daughters, who were just a week old when the photograph was taken, are here shown in the arms of their grandmother, Mrs. Elizabeth Koch. The Hopper home is no strange place to the stork, who has made seven previous visits. This is the first time he has ever been so generous in any one call, however, all of the other children having been born singly. Photograph from Paul Thompson. (Fig. 2.)

so is suggested by the following reasoning.

It is found,[6] for example, that of 37,621 pairs of twins born in Germany and France, there were 13,315 cases in which one twin was a boy, the other a girl. Now an interpretation that may be put on such data is this: These 13,315 cases represent half of the biovular twins—since such twins have equal chances of being of the same or of opposite sex. This means that of the whole number roughly 26,630 cases represent biovular twins and the remaining 10,991 cases represent uniovular twins, from which it appears that 29+% of all twin cases are uniovular.[7] The textbooks of obstetrics published in Germany and France, basing their statement on the relations of foetal membranes, generally give the number of uniovular twins as about 15%. Here is a discrepancy that seems to have been generally overlooked, but it is very probable that the difference between 15% and 29% represents the number of cases in which uniovular twins develop in separate sets of foetal membranes.

POSSIBILITY OF OTHER KINDS

There is another point that cannot well be overlooked in this connection. Prof. Thorndike[8] found that when the degree of similarity between the two members of different pairs of twins is measured and plotted for a large number of cases the resulting curve is smooth and not two-humped as might have been expected. The mode falls at a point higher than that for comparisons between ordinary brothers and sisters, but considerably below the point representing identity. If twins fall only into the two classes usually postulated it is difficult to see how such a result could be obtained. Similar study of other, and if possible, more extensive material is greatly needed.

It may ultimately be possible to show that Thorndike's smooth curve represents the leveling effect of like environment reacting on biovular twins and of somatic variation affecting uniovular twins, but it may also be that the two types mentioned do not represent all the classes of twins, for it must be admitted that theoretically there are other possibilities. One such possibility is suggested by the work of Boveri[9] and others on the eggs of bees and sea-urchins. It was found by these investigators that the entrance of the sperm to the egg *occasionally* stimulates a precocious division of the latter so that the sperm nucleus is able to unite with only one half of the original egg nucleus, leaving the other half to develop (in these lower forms) parthenogenetically. If such a condition were to arise in man, the second half of the egg nucleus might, so far as is known, be fertilized by one of the innumerable superfluous sperm cells, in which case we would perhaps get a pair of twins derived from one egg and two sperms. Such three-germ twins might even be of opposite sex, yet they should be more similar than ordinary brothers and sisters. The at present puzzling distribution of twins in certain families could be explained very well on this assumption, but such a postulate lacks proof, and one must proceed cautiously in introducing new hypotheses.

FREQUENCY OF TWINS

For the student of heredity it is always desirable to know the "normal incidence" of the character under investigation. Knowing this it is possible to calculate, on the assumption that the characteristic appears fortuitously, the probability that it will be found once, twice or oftener in groups of a given size. With this information at hand one may then determine whether the characteristic regularly appears in certain families enough oftener than the laws of chance would explain to warrant regarding it as hereditary.

The approximate incidence of twin births as a whole is easily obtained.

[6] Simon Newcomb, *op. cit.*

[7] Miss Margaret V. Cobb has recently applied the same reasoning to American data with similar results. *Science*, N. S., Vol. XLI, No. 1057, pp. 501, 502. April 2, 1915.

[8] *Archives of Philosophy, Psychology and Scientific Methods*, No. 1, 1905.

[9] This work is scattered through numerous journals dealing with experimental embryology, etc.

TWINS FROM TWO DISTINCT EGG CELLS

As they are of different sexes, it is probable that they are not from the same egg cell; and the difference in their appearance, at first sight, is considerable. But closer examination shows that the hair is the only visible feature in which they differ widely. Photograph from The Nursery Studio, Washington, D. C. Fig. 3.

For example, it is stated[10] that in Prussia one birth in eighty-nine results in twins; in Naples, one in 158; in Russia, one in thirty-two, etc. In certain provinces of China twins are said to be almost unknown. Of the 75,030 births recorded in St. Louis during the five years from February, 1910, to February, 1915, 828 are reported as twins or triplets. This indicates that the incidence of multiple births here is about one to 90.6. Of course these figures tell nothing of the relative frequency of the different classes

[10] Textbooks of obstetrics, etc. The Prussian statistics are said to be based on 13,000,000 births, the Russian on 6,000,000.

FROM ONE OR TWO EGG CELLS?

The most obvious difference between these twins is that one drinks faster than the other. In features the resemblance is close. Yet no one can say from mere inspection whether they represent the twinning that is due to the fertilization of two egg cells, or the twinning that is due to a single egg cell splitting in halves; and as the two kinds of twinning are very likely inherited in a different manner, the study of the problem is made difficult. Photograph from the Nursery Studio, Washington, D. C. (Fig. 4.)

of twins, a decided handicap for the student of heredity.

THE HEREDITARY TENDENCY

The kind of evidence that one gets as to the heredity of twinning may be indicated by reference to a group of fifty St. Louis families. The investigator had no knowledge of any of these families until in each case, the birth of twins was reported to the bureau of vital statistics. On looking into the family histories, it was learned that these fifty new-born pairs of twins had 171 older brothers and sisters born singly and twenty (ten pairs) who were twins. The frequency of twins among the brothers and sisters of twins then is about 1:18. In the mothers' fraternities there had been 318 single births and ten pairs of twins (1:32), and in the fathers', 219 single and eight pairs of twins (1:37). Comparing these figures with the "normal incidence" for St. Louis (1:90.6) one is justified, especially since essentially similar figures are obtained from more extensive data, in concluding that twin production is frequently a family peculiarity.

Analyzing the individual families, evidence is found that what seems to be biovular twinning is hereditary in the direct female line. The tendency to uniovular twinning likewise seems to be transmitted through the female and, since the incidence of twins is higher than normal in the fraternities of the fathers of twins,[11] it is probable that it may also be transmitted through the male. Whether there is any relation at all between the two types is an open question.

While some of these families furnish beautiful charts indicative of an hered-

[11] There is indication that this is also the case with Shropshire sheep. See Rietz and Roberts, *Journal of Agricultural Research*, September, 1915.

itary tendency for twinning, others are frequently met with in which, while there may be a record of many individuals in several generations, only one pair of twins appears. In these instances the twins sometimes seem to be biovular, sometimes uniovular. Such family histories may indicate that while twinning is in some way hereditary in most instances, it may nevertheless at times appear sporadically. The most probable inference to be drawn from this fact would seem to be that the ability to produce twins is possibly common to all strains and that the frequency of twin births in different lines is merely relative. It is not likely, on the one hand, that strains will be found in which twins never occur nor, on the other hand, in which there is nothing but twins. But that such causes as may tend toward twin production[12] are more constant or react more effectually in some lines than in others seems evident. That one of the factors commonly involved in the case of both uniovular and biovular twinning is hereditary seems to be well established, although it cannot as yet be stated whether or not the method of transmission is Mendelian.

SOLUTION NOT IMPOSSIBLE

In the foregoing discussion an attempt is made to give the "setting" of a concrete problem in the study of human heredity for which purpose the question of twinning is selected. The obstacles that are met in attempting to solve this problem are found to be of such a nature as to prevent a quick arrival at final conclusions, but they are not such as to discourage the hope that a definite solution of the problem may be obtained. Before such a solution is reached, however, a number of incidental, and perhaps unforeseen, questions must be disposed of. These questions often call for excursions into somewhat remote fields of investigation, but this fact instead of detracting from the interest of the study or the urgency for its prosecution, adds materially to both. It is only through the careful evaluation and correlation of all these contributary data that entirely satisfactory conclusions can be hoped for.

[12] There is not space to discuss these causes in detail. Many obstetricians consider age an important influencing factor (biovular twins). A slight transient hyper-acidity of the uterine fluids has been suggested as a factor favoring the production of uniovular twins.

Laws to Restrict Miscegenation

Twenty-eight states have laws or constitutional provisions forbidding the intermarriage of negroes and white persons, while twenty States have no laws on the subject, according to Albert Ernest Jenks, who reviews the legislation in the *American Journal of Sociology* (March, 1916). In ten States, bills introduced in the legislatures and aimed at forbidding negro and white marriages were defeated in 1913, largely through the activity of the National Association for the Advancement of Colored People. This association announces that it does not favor intermarriage, but objects to such legislation on the ground that it is ineffective and discriminatory, that it leads to the degradation of negro women, and "for the physical reason that to prohibit such intermarriage would be publicly to acknowledge that black blood is a physical taint, something no self-respecting colored man and woman can be asked to admit." Prof. Jenks points out that in the States which have laws, these laws differ widely in the interpretation placed on the word "negro." "If effectual legal barriers against negro-white amalgamation are desirable," he concludes, "they should perfectly agree as to the legal and racial status of the so-called 'negro,' and miscegenation of every form and every instance between negro and white persons must be made a felony in every American State."

A FOWL WITH HORNS

Here is a Wyandotte cock with well-developed horns on each side of the head. They are similar in character to the spurs which regularly grow on males of the domestic fowl, and are attached to the skin only, having no connection with the skull. The horns are about 1 inch in circumference at the base; the straighter one is 2 inches long and the curved one 3 inches long.

The bird was raised by Dominic Lynch of 1934 Ruan Street, Philadelphia, Pa., and killed last Thanksgiving. The head came into the possession of Charles H. McLaughlin, 1500 North Alden Street, Philadelphia, who brought it to the office of the JOURNAL OF HEREDITY, and furnished the data about it. He had it mounted by David N. McCadden, of the Academy of Natural Sciences, Philadelphia.

From the point of view of development, these horns are merely modified feathers, which in turn are, like the cock's spurs, merely modified scales of the skin. It is difficult to explain why these spurs should have appeared on the bird's head, but there seems to be no reason why they should not do so. On the other hand, it is conceivable that such horns might be produced artificially by grafting spur tissue on the fowl's head when it was young. Mr. McLaughlin asserts that these horns are wholly a natural growth. The taxidermist who mounted the head writes that they appeared to be a natural growth, consisting merely of modified feathers. Such a growth is to be considered merely a freak, and probably would not be inherited. (Fig. 5.)

WHAT THEY SAY ABOUT INBREEDING IN EUROPE

INBREEDING has come during the last few years to be recognized in Europe as one of the most valuable instruments of the live stock breeder. So says Chr. Wriedt, who has spent the winter in the United States as a representative of the Norwegian department of agriculture, studying the position of breeding and genetics here.

Mr. Wriedt notes that, apart from the professional geneticists and a few great breeders, those concerned with live stock in the United States still display a good deal of suspicion and misunderstanding of the use of inbreeding and linebreeding. European breeders, too, used to be skeptical. Their attitude was influenced largely by the authority of the German scientist, Settegast, who dominated the field of live stock breeding half a century ago, and who denounced consanguineous breeding in every form.

"The first impartial investigation," says Mr. Wriedt, "was started by Count Georg Lehndorff, who was in charge of the governmental horse-breeding operations in Prussia for a generation, and exercised a great influence for good on the art of breeding. Through studies of the pedigrees and progeny of thoroughbred horses, he came to the conclusion that moderate inbreeding[1] was largely responsible for the best records; and his publications, beginning about 1880, mark the commencement of the new school of breeding in Germany.

"But the turning point, in Germany, is the publication in 1909 of A. de Chapeaurouge's great book on inbreeding, in which he analysed the pedigrees of English thoroughbreds, Anglo-Norman trotters in France, and the best private studs of East Prussia. He was in many ways a pupil of the Australian, Bruce Low. The greatest defect of de Chapeaurouge is that he was born too soon to be a good geneticist—he is quite out of sympathy with the Mendelian movement.

"His work was based wholly on practical breeding; on the analysis of actual pedigrees. It really led to the foundation of a whole school of breeding on the continent, and to the foundation of the German Genetic Association,[2] a powerful organization which has worked incessantly to promote intelligent breeding.

PEDIGREE-STUDY EMPHASIZED

"The guiding spirits of this association are two able men, Dr. Felix Hoesch, the president, a breeder of Belgian horses and swine, and Dr. Georg Wilsdorf, the secretary, who is in charge of livestock breeding in the province of Brandenburg. These men combine to an unusual degree the viewpoints of the practical breeder and the geneticist, and under their leadership the German Genetic Association has published a series of valuable yearbooks, fifteen monographs on various breeds, and a score of bulletins on topics in scientific breeding, particularly as related to the study of pedigrees. Pedigree-study is, in fact, the keynote of the association's activity, and the interest which the breeders take in it may be judged from the fact that Wilsdorf's 'Pocket Pedigree Book' for the black and white cattle, a breed corresponding to the Holstein-Friesians, is now in its fourth edition."

"And what do they learn from all this pedigree study?"

[1] In other words, what we call line-breeding. Much of the so-called inbreeding in Europe is not of a close character, and in the United States would never be called inbreeding, but merely line-breeding. The difference, of course, is merely one of degree.

[2] Deutsche Gesellschaft für Züchtungskunde. Its headquarters are in Berlin, and it is said to have 3,400 members.

"In general," Mr. Wriedt said, "They learn this: that in every breed the valuable strains or families are found to contain the names of a very few ancestors, repeated a great many times. In short, that the valuable part of any breed is due to a small number of animals, usually sires; these sires, which we would call prepotent, have been used as much as possible, through inbreeding and linebreeding.

"The secret of the great successes in live stock breeding, then appears to be merely that the valuable 'blood lines' were picked out and conserved through inbreeding."

"And this inbreeding does not lead to disaster?"

"Not at all, if the animals are good; Take for example the famous Kladrub breed of horses in Bohemia. It is probably the purest breed in the world—one of the few breeds of horses that has any right to call itself pure.

THE KLADRUB BREED

"Its foundation was a Spanish breed of heavy carriage horses which had been closely bred and kept pure for many hundreds of years, when it was taken to Austria in the sixteenth century for the use of the court. The chief characteristics of the breed are the Roman nose, arched neck, heavy crest, great height (17 or 18 hands) and extravagant gait. The breed is a very small one, rarely consisting of more than a hundred individuals, but they are regarded in Austria as the finest parade horses in the world, and may be used only by the royal family and by the Archbishop of Olmütz in Moravia. They are ordinarily seen only on great occasions, when the emperor drives in state behind six or eight of them, all grays or all blacks—the only two colors found in the breed. As they are all for 'show' their trotting speed is only a few miles an hour—this gives them a chance to exhibit their fancy action.

"New blood is very seldom introduced into this breed, and because of the small number of animals existing, inbreeding must have been quite close for several centuries. In recent years no stronger inbreeding than cousin matings has been practiced; yet the Kladrub horses probably represent in their history more inbreeding than any living breed. Are they degenerate? Not a bit. The only unusual result is that it has become very difficult to tell when the mares are in heat. But there has been no diminution in fertility, nor any increase in the number of weak or defective animals. They are very slow to mature, seldom reaching full size before the sixth year; on the other hand, they remain vigorous to a very advanced age.

"This long-continued example of inbreeding shows that if the stock is good at the start, inbreeding will fix the type. It is a pity that these animals are not available for experimental purposes, for according to theory they ought to be extraordinarily prepotent. It would be of great value to find out whether this is actually the case when they are mated with other breeds.

"The Percherons offer a great example of inbreeding and prepotency," Mr. Wriedt continued. "Most of the good animals today trace back in several lines to the two stallions Brillant 755 and Brillant 756.

A GREAT PREPOTENT SIRE

"But the most conspicuous example of prepotency which has ever come under my own observation is that of the Jutland stallion, Aldrup Munkedal, born in Denmark in 1893. He is sire of practically all the sires of that very valuable and by no means inconsiderable breed called the Jutland breed."

"And you believe, I suppose, that inbreeding increases prepotency?"

"Certainly. Prepotency is simply the condition of being purebred—homozygous—for a large number of dominant characters.

"If we understand that prepotency depends on having received the same dominant characters from both lines of descent, we realize that the surest way to produce prepotent animals is by inbreeding, where they are certain to get some, at least, of the same characters from both parents. Occasionally one may get an equally prepotent animal as the result of a cross, but then it is

THE PUREST BREED OF HORSES

One of the few breeds of live stock that can properly be called pure is the Kladrub breed of horses, produced in Bohemia for the use of the Austrian court on state occasions. They have been carefully selected and inbred for centuries, and are now considered by the Austrians to be the finest "show" horse in the world. Only two colors occur, black and light gray. Inbreeding for dozens of generations has done no damage to this breed, despite the widespread popular belief that long-continued inbreeding is certain to be injurious. The carriage of Kaiser Franz Josef is shown, at the recent Eucharistic Congress in Vienna, photographed by Underwood and Underwood. (Fig. 6.)

merely a matter of chance. There is an excellent illustration of this in Hungary, with which you may not be familiar.

"The Nonius breed is one of the most important of Hungarian breeds of general purpose horses. It is founded wholly on one stallion, Nonius, who was produced in France more than a century ago by mating an English halfbred to a Norman mare. In 1815 the Austrians carried him away as one of the prizes of war; he proved to be extraordinarily prepotent, in spite of his mixed ancestry, and is responsible for the existence of the valuable breed which bears his name today."

"And the Europeans are really improving their stock rapidly, by picking out the good blood lines and inbreeding?" I inquired.

"Undoubtedly. In Germany, Austria, Holland and the Scandinavian countries, the movement has made great progress. It had done less in France and Great Britain. In general, I suppose this school of breeding is the strongest, where the publications of the German Genetic Association are best

known. The president of that association, Hoesch, has made a wonderful success in building up the German country swine through moderate inbreeding, based on three prepotent boars."

"Not only is it important to know the good blood lines, but equally to know the bad blood lines. Sometimes a very injurious line of descent is diccovered, quite unexpectedly, owing its origin to an animal who perhaps was a first-class performer but not a good breeder. We have one notorious case in a government-owned stallion in Norway, who appears to have been prepotent, but in bad, not good, characters. Every time we find his name in a pedigree, we expect to find unsatisfactory results."

EUROPEANS KNOW THEIR BREEDS

"Do you think that European bree ers know their breeds better than Americans do?"

"I fear there can be no doubt about the answer to that question. So far as Germany, Holland, and Scandinavia are concerned, the bulk of the breeders are certainly better acquainted with the blood-lines of their breeds, than are the bulk of American breeders. This development has been rapid—it is largely since the time of de Chapeaurouge, or say the last seven years; for de Chapeaurouge worked seventeen years on pedigrees before he published his great book on inbreeding."

"And your advice to Americans would be——"

"That they study their pedigrees more diligently. The progress they have made—astonishing progress, in many lines—has been due to the isolation of good blood lines and the perpetuation of them,[3] but this has been mostly unconscious. They will go more rapidly and surely if they make certain just what are their best strains, and then use those strains to the limit. They will understand and enjoy their work more if they will study genetics, although I do not pretend that a knowledge of genetics will work any revolution in breeding practice at present."

"Can't we proceed still more rapidly if we import the best animals of Europe?"

"Oh, that is all a mistake!" Mr. Wriedt exclaimed vigorously. "You've done enough importing in most breeds. It was a real blessing to America that foot-and-mouth disease stopped the importation of Holstein-Friesian cattle from Holland. You must remember that there is only one animal in a thousand that really builds up the breed. Now you undoubtedly have many such animals at the present time. The thing to do is to find them and use them, build on them. Then you have a permanent foundation; while if you continue importing animals from Europe, even though they be individually fine specimens, they may not be just what you need to establish strong blood lines in your breeds."

"But surely we couldn't give up importing draft horses."

"Quite true. America's greatest lack, in live stock, seems to me to be a good American breed of heavy horses. But you can easily produce such a breed, if the value of it is more highly regarded. That, and the full utilization of the excellent light horses of Virginia, appear to me to be the two most promising lines of horse breeding in the United States at the present time.

"Finally, let me repeat the lesson which European experience offers to American breeders. Study the pedigrees of your breeds, hunt up the 'blood lines' that are producing the greatest number of good performers, and perpetuate, multiply, intensify these blood lines by moderate inbreeding or, if necessary, by the strongest forms of inbreeding. If this is combined with stringent selection of only the best animals, the breeder cannot fail."

[3] A good example of this is furnished by the rapid improvement of Holstein-Friesian cattle. First, the breeders have found out which are the really valuable animals—the "seven day test" is a great help to that end; second, they are able easily to trace the relationships of these animals, thanks to the convenient *Blue Book*.

GROWING MELONS ON TREES

The Papaya an Important Tropical Fruit Which Offers Great Opportunities to Breeders—Remarkable Irregularities in Sex—Changing Male Trees into Females[1]

J. E. Higgins

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THE papaya, or melon tree, is one of the most important tropical fruits and because of its delicious quality and great yield is destined, I believe, to be one of the valuable crops in the world's horticulture in the future.

Its future inportance will depend largely on the work of plant breeders, to whom it offers some unusually interesting features which I propose to consider in this paper.

To those unfamiliar with the tropics, it may be said that this tree grows from a small seed to a height of 10 or 15 feet in a single year, takes on a load of fruit equal to that of a 10-year-old apple tree, and begins to ripen it about twelve months from planting. The large and beautiful yellow fruits, weighing on an average from three to six pounds, are much appreciated in the parts of the tropics where attention has been given to their cultivation, and are eaten by all classes of people. As fruit they fit into the same place in the dietary as the muskmelon, but to one who would inquire what they taste like the only reply is—they taste like the papaya.

The species has been known by many common names in Mexico, Central America and the West Indies, all of which countries have been mentioned by different writers as its probable home. In English-speaking countries it has frequently been called the papaw, but this term should be dropped since its application to the North American papaw, a wholly unrelated species (*Asimina triloba*), is well established.

The papaya will continue to bear for many years, but its period of profitable production is only two or three years, after which it is cut down to give place to young and vigorous stock. The growth is so rapid and the tissue so soft that a single stroke with a cane knife will sever the entire trunk, although it may be more than a foot in diameter. It might be supposed that so soft a structure could not support the several hundred pounds of fruit which not infrequently are borne, but since it is all carried close to the trunk and the strain is practically vertical, the breaking of a papaya tree is rare, although the large, picturesque, palm-like leaves expose a large surface to the wind.

PECULIARITIES OF SEX

From a plant breeder's point of view, the most remarkable thing about the papaya is its sex. Speaking broadly, one would say that the male and female flowers are borne on different trees. This is an unsatisfactory situation, for male trees are of no value to the grower, except in the limited number necessary for pollination. Yet when the papaya is grown from seed, as has usually been done in the past, most of the resulting plants are males, and the grower's profit is thereby much decreased.

There are two ways of avoiding this difficulty. One which is already being used is to propagate the trees not by seeds but by grafting. Then one will propagate only female fruit-bearing trees, with just a few males. This method is very useful in prolonging the existence of valuable seedlings, but it is

[1] In the present paper the author has quoted freely from The Papaya in Hawaii," by J. E. Higgins and Valentine S. Holt. Hawaii Agr. Exp. Sta. Bul. No. 32, 1914.

HE LIKES PAPAYAS

Most people do, even at the first trial. The papaya has a medicinal value, but it is a medicine that is decidedly pleasant to take. Belief in the great future of the papaya as a food crop, however, is based not so much on its medicinal value as on its food value and its heavy yield. Photograph by Wilson Popenoe, Miami, Fla. (Fig. 7.)

somewhat expensive for a tree whose period of profitable production is so brief.[2]

The other way is to breed a race of papayas which will carry both male and female flowers on the same tree, or which will bear *perfect* flowers which furnish the pollen needed for the ovaries on the same tree. A race of this sort could be propagated from seed, and there would be no loss to the grower through the production of non-fruiting males, as at present. Every tree would be fruitful, just as is the case with the apple, pear, and most fruits.

The production of a hermaphrodite race like this is made possible by the fact that such trees exist in nature. The male flowers are not invariably confined to one tree and the female to another, but a dozen or more types of tree can be recognized; and these types form a precious material for the plant breeder. They have been described at some length in Bulletin No. 32 of the Hawaii Experiment Station, but I shall mention the more important here.

TYPES OF TREE

Form 1. The first form to be considered is the ordinary female or pistillate tree of the dioecious stock. The female tree produces flowers exclusively pistillate, with no indication of even the remnants of stamens (Fig. 8). The ovaries and the resulting fruits are of various shapes, inclining to the obovoid, with a diameter somewhat shorter than the major axis, and the surface smooth or only slightly ribbed. The fruits are usually borne singly on very short peduncles in the axils of the leaves.

Form 2. The male tree (Fig. 12), the counterpart of that just referred to, produces only staminate flowers which, however, possess rudimentary or abortive pistils (Fig. 11), and hang in great profusion in cymose panicles on peduncles 2 to 5 feet in length. The flowers, unlike those of the female tree, have a long corolla tube in the throat of which are 10 stamens arranged in two series, the one having slightly longer filaments than the other. At the base of the tube may be found a small rudimentary pistil, quite devoid of any stigma. Since all the flowers are of this type the tree abounds in pollen, but produces no fruit. In foliage and habit, other than as described, it resembles the female, and is indistinguishable until flowers appear.

Form 3. *Correae* of Solms-Laubach.[3] This form is a departure from the last and is illustrated in Fig. 11. It is identical with the tree just referred to except that a few of its flowers have pistils capable of fecundation. The rays of the stigmas may be perfectly formed or one or more may be aborted, giving rise to an unsymmetrical or gibbous fruit in which the corresponding portions of the placenta have failed to develop. The ovaries of the well-formed hermaphrodite flowers incline more to the elongated and cylindrical form than those of the pistillate tree and result in correspondingly different fruits. The corolla tube is elongated as in the staminate flowers and the stamens are similarly located in the throat of the corolla, being brought into proximity with the stigmas. These bisexual flowers are larger than the staminate but in other respects are similar, except as has just been indicated. The number of such flowers varies from few to many, there being at times as many forming fruits on the long pendulous peduncles as are to be found on some pistillate trees, notwithstanding the fact that many have fallen. Often as the fruit develops the peduncle is not strong enough to sustain the weight and breaks off, such long fruit-stems inviting disaster from the winds.

Form 4. *Elongata*, a hermaphrodite papaya (Fig. 9). This tree produces two types of flowers. One of these types is hermaphrodite and is in every way similar to a well-formed bisexual flower on the *Correae* form (form 3), except that it usually is larger and its pistil is more elongated. The other type of flower is staminate and is identical in appearance with the staminate flowers already described. Because of the presence of these two types of flowers, this form has been referred to in the earlier publications of this station as the monoecious papaya.[4]

As experiments have proceeded, however, it has been discovered that the pollen from such staminate flowers, except in the case of one tree, has failed to fecundate any pistils up to the present time, and it has been applied to every type of pistil found in the station collection. Since these flowers apparently do not function it seems incorrect at present to apply to this form of the papaya the term monoecious. They may rather be termed either pseudo-monoecious or hermaphrodite.

Form 5. Sterile hermaphrodite.

Form 6. *Forbesi* of Solms-Laubach. Briefly

[2] It has recently been observed at Miami, Fla., that the papaya degenerates rapidly when propagated by grafting. Grafted plants of the third and fourth generations from the original seedling of the Simmonds variety develop to a height of 3 or 4 feet only, produce a few small fruits, and are always yellowish and sickly in appearance. On this account, propagation by grafting may have to be abandoned. The papaya would appear to be a promising subject for experiments on degeneration in asexually reproduced plants. It can easily be grown in greenhouses and should prove a most interesting plant for physiological experiments.—The Editor.

[3] Die Heimath und der Ursprung des cultivirten Melonenbaumes, *Carica papaya*. Bot. Ztg., 47 (1889), Nos. 44–49.

[4] Hawaii Sta. Rpts., 1910, 1911, and 1912.

PAPAYA TREE WELL LOADED WITH FRUIT

Such crops as this, quickly obtained, make it seem probable that the papaya will have an important part in the horticulture of the future. The tree here shown represents the pistillate type, all of the flowers of which are female or fruit-producing. Inserted at the lower right hand corner is one of these flowers. (Fig. 8.)

stated, the most striking characters of this plant are as follows: On the long, pendulous peduncles, characteristic of the male tree, this plant produces its three types of flowers, staminate, pistillate, and hermaphrodite. The staminate are identical with those of the ordinary male tree and the pistillate with those of the female tree, but the hermaphrodite differ from those described above (form 3). These have a very much shortened corolla tube as in the case of the pistillate flower, the lobes being divided almost to the base of the ovary. On the edge of this short tube, quite near the base of the ovary, are attached only five stamens, and these are supplied with long filaments, which rest in furrows between the lobes of the ovary. These lobes are united at the base, but often separable at the upper ends. The resulting fruit is deeply furrowed.

Form 7. *Pentandria.* This form produces hermaphrodite flowers of the same type as those just described (form 6). They have the corolla tube reduced to almost negligible length and the five stamens inserted on long filaments on this tube, near the base of the ovary. The ovary is deeply furrowed, with the stamens lying in the grooves between the lobes, thus giving rise to a deeply furrowed fruit. There are also staminate flowers of the ordinary type, and these are borne with the hermaphrodite in short clusters as in the case of form 4.

CHANGE OF SEX

It is a fact worthy of note that some of these forms are not constant. One may assume the rôle of another. Perhaps the most primary change of sex which takes place is to be observed in the appearance of hermaphrodite flowers on trees that have previously produced only staminate inflorescence. That is, form 2 may pass into form 3 or form 6. Not only is it known that such changes take place, but the conditions which may bring them about have been under observation. This "fruiting of the male papaya" takes place most freely in cool climates outside the tropics or at high altitudes. In Hawaii it may be seen that these trees fruit more abundantly on the mountains than near the sea level. In torrid climates the fruiting of the "male" is rare. It is to be remembered in this connection that all the staminate flowers of the male trees possess an undeveloped or an abortive pistil. The only change in the cases mentioned consists in the development of this pistil, resulting in a hermaphrodite flower.

It is a matter of record that complete change of sex occasionally occurs when the top is cut off from a purely staminate tree. Such treatment may result in the new tree top producing pistillate flowers exclusively, or the tree may become a hermaphrodite of the *Elongata* form. A tree of changed sex characters is shown in Fig. 13. It was formerly staminate and, being without fruit and useless to the owner, it was cut back to a stump and was used to suspend a back yard clothes line. Without any other known change in conditions it took on the fruit-bearing characters shown in the illustration and produced pistillate flowers exclusively on all of its branches. It is to be noted, however, that such changes take place with no certainty or regularity. At the Hawaii Experiment Station, the cutting back of a considerable number of staminate trees on some occasions has produced no difference in sex, while at other times a small percentage of pistillate and of hermaphrodite fruit-bearing trees have resulted.

It is worthy of note that no record has been found by the writer in the literature of the papaya which would indicate that the pistillate or female tree has ever changed its sex.

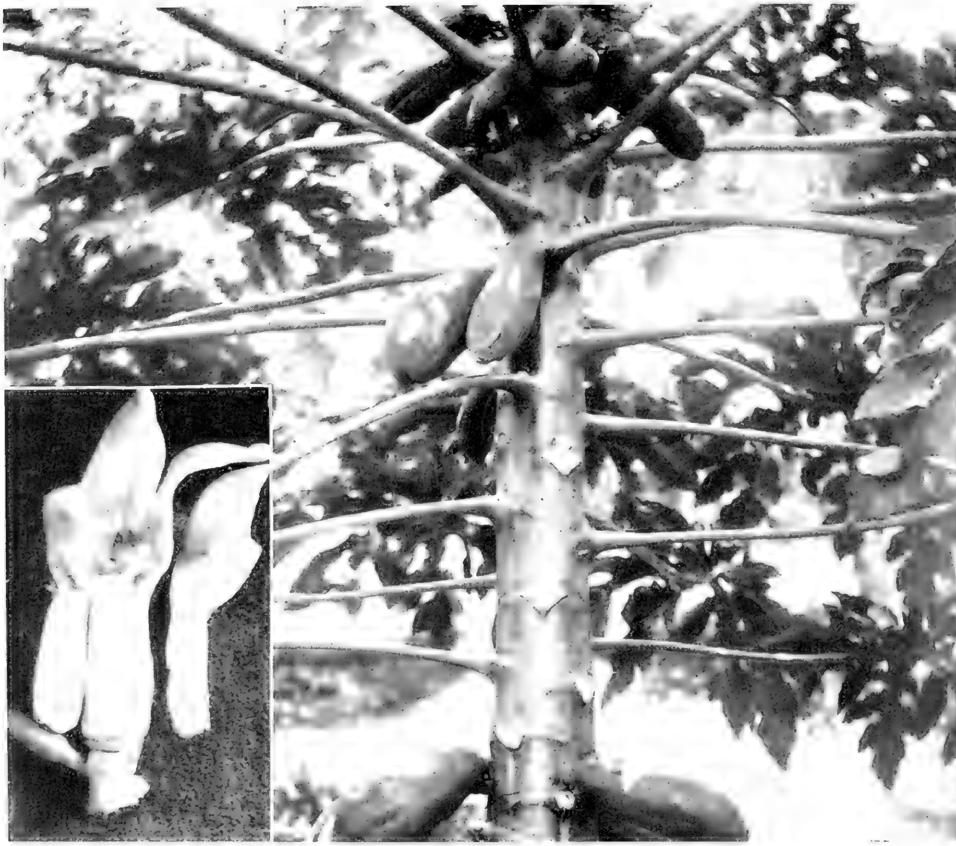
ORIGIN OF THE HERMAPHRODITE

Because the hermaphrodite form is of great importance from the standpoint of the breeder, as will be shown a little later, it may be interesting to inquire into its probable origin. It is apparent that the form *Correae* is only a slight departure from the ordinary male or staminate tree. Now comparing *Correae* with the hermaphrodite *Elongata*, it will be observed that the hermaphrodite flowers on both trees are the same and produce fruit of the same elongated form, but the trees differ only in three minor particulars: (*a*) In *Elongata* the flower clusters are greatly shortened; (*b*) It produces larger fruits usually; and (*c*) Its staminate flowers do not produce fertile pollen. It would appear that *Elongata* has been derived from the ordinary male or staminate tree, through *Correae*, by an increase in the number of hermaphrodite flowers and the shortening of the clusters and of the fruit stems.

Very little effort has been made to

A HERMAPHRODITE TREE

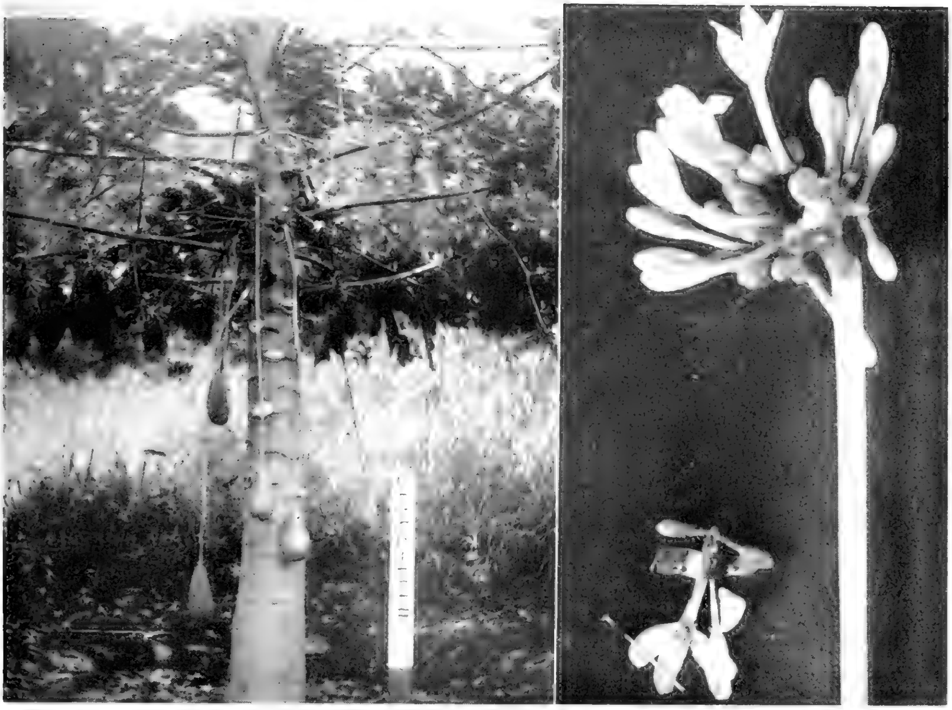
The Elongata type of papaya, here shown, produces two kinds of flowers. One is a male, staminate, or pollen-bearing flower, which, however, ordinarily bears no good pollen; the other type of flower is a bisexual one, the flowers not only producing fruit, but pollen as well. Trees of this type offer great promise for producing a strain that will combine the two sexes on the same plant, and not make it necessary, as at present, to have a number of male trees which, although they produce pollen, yield no fruit and therefore are counted by the grower as drones. (Fig. 9.)



AN UNDESIRABLE TYPE

This is the elongata, a more productive specimen of which was shown in the preceding illustration (Fig. 9.) In the present case, a majority of the flowers have been male, and therefore gave no fruit. The goal of the breeder will be to weed out such trees as this and keep only those which bear a minimum number of male flowers and a maximum number of hermaphrodite flowers. Inserted in the lower left-hand corner is a hermaphrodite flower from the elongata tree, showing both stamens and pistil. (Fig. 10.)

improve the papaya by systematic breeding. There has been some selection on the part of growers who naturally plant the seeds from particularly pleasing fruits. Because other forms have been little known and observed, the most of such selection has been with the dioecious papaya, and here there is an inherent difficulty even in the way of the scientific breeder. Seed from a pistillate tree will necessarily be a cross of two individuals. The characters of the female plant may be known, but those of the male plant are utterly unknown. The parent stock from which both came may be known, but since there is wide variation in the fruit of two pistillate trees from the same stock it is reasonable to suppose that there will be the same wide variation in the male or staminate trees. The variation between the pistillate trees can easily be determined because their fruits are in evidence and can be tested; but the characters which are inherent in the male or staminate tree, and which will be transmitted by it to its progeny, can be determined only through the long process of actual hand pollination, the sowing of the seed thus produced, and the testing of the fruit. Even then what portion of its excellent or indifferent qualities may have been inherited from its male parent cannot be known.



MODIFIED FORM OF THE MALE TREE

The Correae type, shown at the left, is essential a male tree which has a few flowers capable of bearing fruit. The long stems on which the fruits hang are a typical feature. At the right are shown staminate (male) flowers, one of which has been cut open to show its structure. (Fig. 11.)

Furthermore, the difficulty is increased by the fact that papaya trees usually degenerate after a few years. At least pistillate trees usually fail to produce good fruit after a few years of growth, although they may continue to produce indifferent fruit for many years. Therefore, even if the inherent characters of the male or staminate tree could be determined with reasonable accuracy, before any such determination could be made the tree would have become too old to be in a reliable state of virility if it degenerates as rapidly as the pistillate tree.

Propagation by grafting will aid in overcoming this difficulty, but it appears reasonable to suppose that the process of producing a stable variety of good quality by the use of this dioecious type would be extremely long and tedious. The hope, therefore, must lie in the use of a hermaphrodite type. Here it is possible to select an individual of known qualities. This may be used as the sole parent stock or may be combined with another parent of known qualities. What mixtures there may be in the individual at the start may not be known; but through repeated selections and the elimination of undesirable characters, it should be possible to produce a reasonably pure strain, provided, of course, that the stock is kept pure by constantly avoiding cross-pollinations with plants of different characters, a process which is necessary in all plants reproduced by seed and whose flowers are subject to accidental cross-pollination.

A further practical difficulty in the use of the dioecious type, from the standpoint of the papaya grower, as well as the breeder, is the fact that a very large proportion of the trees from any given lot of seed are likely to be

staminate, or males, and therefore useless, only a few trees being necessary to pollinate all the pistillate trees. It is impossible so far to distinguish the staminate from the pistillate trees in the early stages of their development. Therefore, in any papaya orchard planted with the dioecious type, a very large percentage of the trees must be cut out after they have grown almost to maturity, resulting in unevenness and irregularity in the orchard and much loss of time and space. For this reason, together with the difficulties of breeding, the dioecious type probably will be largely eliminated.

BREEDING HERMAPHRODITE FORMS

Turning to the hermaphrodite forms with more hope of results, we find that a number of experiments are being conducted. Here it is possible to deal with a single individual mother plant. One of the first facts to be determined is the extent to which the offspring of such a parent may be expected to be fruit-bearing trees. It was known from earlier observation, without any definite experiment, that a large number of the seeds from a fruit of a hermaphrodite flower produce fruit-bearing trees, either pistillate or, like the parent, hermaphrodite.

A tree was found in a Honolulu orchard producing fruit of excellent flavor. The fruit from which the seed was taken was of the long cylindrical form, but it cannot be stated that all the fruits on the tree were of that shape. Its flowers were apparently staminate and hermaphrodite, and so far as observed, of the Elongata form, but it is probable that the apparently staminate flowers were non-functioning. The flowers had not been hand-pollinated, and it is therefore impossible to state whether they were self-fertilized or otherwise. The seeds were planted May 2, 1910, and later thirty-five of the young plants were set in the orchard. Of these, thirty-four were hermaphrodite and one was a staminate tree. The hermaphrodite flowers on most of the trees were of two types, some of the Elongata form and others resembling Pentandria, with corresponding difference in the fruits. The best one of the trees from the standpoint of uniformity of cylindrical shape in fruit was also of very good flavor and a reasonably good producer; it was selected for further breeding. Two of its flowers were hand-pollinated each with its own pollen and carefully protected. The seeds collected from these two fruits were planted, and it was found that 94% of the resulting trees were fruit-bearing, being either pistillate or some form of hermaphrodite. This is an encouraging result, so far as the elimination of the males is concerned. It is probable that by the continued use of hermaphrodites of the Elongata form as a source of pollen as well as for the pistil-bearing parent, male forms may be largely eliminated.

CROSSING THE DIFFERENT FORMS

It has been found possible to cross quite freely most of the different forms of the papaya, as would be expected from the fact that they all are merely slight modifications of the same species. Among the experiments now in progress is one to determine the sex resultants arising from the crossing of a pistillate of dioecious origin with pollen from a hermaphrodite. If, as is expected, the progeny will be chiefly pistillate and hermaphrodite, then desired characters that may be found in any dioecious stocks may be combined with hermaphrodite stock.

Like other tropical fruits, the papaya still offers an almost virgin field to the plant breeder. But enough has been done to make it certain, I think, that a strain can be established which, combining the two sexes on the same tree, will produce from seed a desirable fruit, without the production of a great many useless male trees.

The successful achievement of this task, and the dissemination of the resulting strain, will give a tremendous impetus to the culture of the papaya. But there is still another possible field of work—namely, crossing with other species.

It is probable that there has been considerable hybridizing of Carica by natural means, and breeders have not wholly neglected the genus. I will not

A MALE TREE, THE "DRONE" OF THE GROVE

These trees produce a great profusion of pollen, but no fruit. They are consequently not looked on with favor by the grower. But under the present system of propagation by seeds, half of the trees will be of this drone type. They must be cared for until they reach maturity, for one cannot distinguish the staminate from the pistillate trees until they flower. These trees therefore occupy the land and take the time of the cultivator for a year, only to prove worthless. Plant breeders have undertaken to obviate this great practical drawback to papaya culture in two ways: by propagating, vegetatively, only fruit-producing trees; and by getting a strain which, when propagated from seed, will produce trees every one of which will bear fruit. (Fig. 12.)

CHANGED FROM A MALE TO A FEMALE

This tree started life as a male in the back yard of Dr. John T. Gulick, the geneticist, in Honolulu. As it produced no fruit, it was cut down to a stump and allowed to earn its keep by supporting a clothes line. Losing its head apparently brought a change of heart, for it proceeded to send forth new branches which were not male, but female, and bore good fruit, as the photograph shows. Such reversal of sex by heavy pruning is not rare in the papaya, but the change does not always take place when desired. (Fig. 13.)

attempt to enumerate the various species which have been crossed, since they have so far led to no commercial result. But it still seems possible that hybridization of the papaya with some more hardy species will produce a fruit which can be grown outside the tropics. *Carica cundinamarcensis* is one of the hardiest species. It stands considerable cold weather and bears an acid fruit which is pleasant to the taste when properly cooked. If this could be combined with the papaya, a hardy form might be produced which would mature a good fruit in the southern United States, for example; while the true papaya can with difficulty be made to mature good fruit even in southern California, although it flourishes in southern Florida.

IDEALS IN BREEDING THE PAPAYA

There seems to be no good reason to doubt that it will be possible to breed a papaya combining at least many of the most desirable characters and to hold the variety reasonably stable by the same means as are employed in maintaining seed varieties of vegetables and garden flowers. This presupposes segregation or hand pollination in either case, the latter being the method which most breeders will be compelled to follow because of the proximity of other varieties over which they have no control. The simplicity of hand pollination in the papaya and the large number of seeds resulting from one operation render it a very practical means even for commercial seed production.

It may be well to outline here some of the ideals which the breeder should have in mind in his search for Mendelian characters which may be combined.

1. Vigor of tree—It is important with the papaya, as with other species, to use vigorous individuals as parent stocks.

2. Early and low fruiting habits—There is a wide variation in the plants in this respect, some producing no fruit on the first five or six feet of the stem, while others bear fruit which almost touches the soil. It is believed that this character may be transmissble, and the advantage of early and low-bearing trees is obvious.

3. Freedom from the branching habit—Trees that produce side branches freely require considerable pruning to prevent the numerous new shoots from taking the nourishment which should go to the fruit.

4. Productivity but not excessive bearing—Trees that have long bare spaces on their stems and those whose fruits are so numerous as to crowd each other should be avoided in favor of such as have the fruits well spaced with just sufficient room to mature normally.

5. Hermaphroditism—The reasons for preferring hermaphrodite stock have already been pointed out. It is essential to a profitable industry that the number of "drone" male trees be kept very small.

6. Suitable size in fruit—The size that will be most desirable will depend upon the purpose to which the variety is to be put. For home use or for the fresh fruit market the extremely large varieties are not popular, and the breeder of table varieties will not, therefore, attempt to originate such forms. On the other hand there is a place for these, if the fruit is to be grown as feed for poultry or other live stock. For papain production, other things being equal, the large fruit would be best.

7. Yield in papain[5]—Where the production of papain is made an industry there can be little doubt that the average yield of this drug could be very greatly increased by judicious breeding.

8. Uniformity of shape—The breeder must seek to establish varieties which will have reasonable uniformity of shape as well as symmetry and smoothness. It is not necessary that all varieties be alike, but there must be uniformity in pack. In breeding from hermaphrodite trees there will be a large number of pistillate trees in the offspring. Although the long form is not necessarily confined to the hermaphrodite tree, nevertheless pistillate trees do not usually yield fruit of this shape. For this reason the

[5] The juice of the fruit and sap of the papaya tree contain an active principle called *papain*, the effect of which is similar to that of pepsin. It is used medicinally, and also to clarify beer. Its digestive property is so great that raw meat placed in diluted juice will disappear altogether.—*The Editor*.

breeder may think it best to work for two forms of fruit—the long, tending to cylindrical, for the hermaphrodite, and the obovoid for the pistillate. The fruits of such an orchard would be packed as two varieties.

9. Uniformity in ripening—This is an important consideration. Some papayas ripen and decay at the outer end or the point while the inner half near the stem is too green to be eaten. The ideal papaya in ripening shows its first yellowing along the ribs about midway of the fruit and ripens uniformly toward each end.

10. Coloring before softening—Some fruits ripen with very little color, while others acquire a beautiful golden yellow when still hard, and may be kept for several days. The latter are so much more attractive on the table and in the market that they should be sought after in breeding.

11. Color of flesh—Those of pale whitish flesh must give place to the fruits of yellow, pink, or red color within. Recently some have been grown at this station with a quite decidedly reddish hue.

12. Easily separable placenta—If the placenta adheres tightly to the inner portions of the fruit and is more or less buried in the flesh, it is difficult to remove the seeds without marring the appearance of the fruit. On the other hand, it is a distinct advantage if the placenta and seeds can be readily removed without scraping the flesh.

13. Flavor—This is without doubt the most important factor to be considered. Experience has shown that specific flavors can be transmitted, and this affords the breeder an opportunity to originate and establish varieties of high quality. These flavors cannot well be described, but are easily recognized and appreciated.

14. Keeping qualities—The ideal papaya should be a good keeper, and this character has been found often enough in the fruit of individual trees to lend much encouragement to the breeder.

Crime and Heredity

The National Committee on Prisons has organized a committee on eugenics to consider the constitutional basis of criminalistic behavior. The inquiries into family history are to be made by a field worker trained by the Eugenics Record Office. At present, opinions of experts on the subject differ widely.

To Study Exceptional Children

In connection with Stanford University, in California, there has recently been established a research fellowship for the psychological and pedagogical study of backward and mentally defective children. The endowment is known as the C. Annette Buckel Foundation. The first fellow under the foundation was J. Harold Williams, who devoted himself chiefly to the study of the intelligence of delinquent boys, largely at the Whittier (Cal.) State School. A second bulletin has been issued by Lewis H. Terman, outlining the aims and purposes of the foundation, from which it appears that five lines of research are proposed: (1) Backward and feebleminded children; (2) delinquent or potentially delinquent children; (3) nervous, morbid, or psychopathic children; (4) children of superior ability; (5) normal children. The prospective plans for the development of the work call for an enlargement of the present foundation to include two or three additional fellowships with an annual value of $1,000 each; two office or laboratory assistants; one or two field workers to collect data on the heredity of exceptional children, and a research professorship. More remotely there is contemplated the establishment of a hospital, school or home for the first-hand study of exceptional children, and for the practical training of special teachers of such.—*Eugenical News.*

ROBERT ROY (FIG. 11)

That albinism in rats, mice, guinea pigs, rabbits, etc., is inherited as a recessive trait is the experience of all breeders. That albinism in man follows the same law is *a priori* probable but it is obviously difficult to secure cases for what is the best test of recessiveness, viz., the exclusively albinic progeny of two albinic parents.

Some years ago Mrs. Davenport and I recorded (*American Naturalist*, December, 1910) three pedigrees giving the progeny of the matings of two albinos.

MRS. ROBERT ROY (Fig. 15)

They were all based on the statement of Robert Roy, of New York City, whom I have always found trustworthy. These families were recorded as the Luc. family, two children, both albinos—of albinic parents; the Pri. family, one albinic child of two albinic parents; and the R. family, an albino child of two albinic parents. The surname of this last family which we did not then feel at liberty to divulge, but which we are now permitted to publish, is Roy. Robert Roy (Fig. 14), of New York, now about fifty-five years of age, was one of a fraternity of ten, all but himself pigmented—one with jet black hair. Their father had very dark brown hair and their mother sandy hair. Robert Roy married, about 1880, a Miss

THEIR SON, K. C. ROY (Fig. 16)

Annie L. W. (Fig. 15), with whom he was associated in shows. Three other of her fraternity were albinos and eight were pigmented. Their only child, born, like his mother, in Pennsylvania, was King Charles Roy (Fig. 16). The resemblance of the son to his mother is marked in the lower parts of the face; to his father in the upper part of the face. I may add that the albinism is practically complete in father and son; there is no nystagmus but rather marked photophobia, especially in the son.

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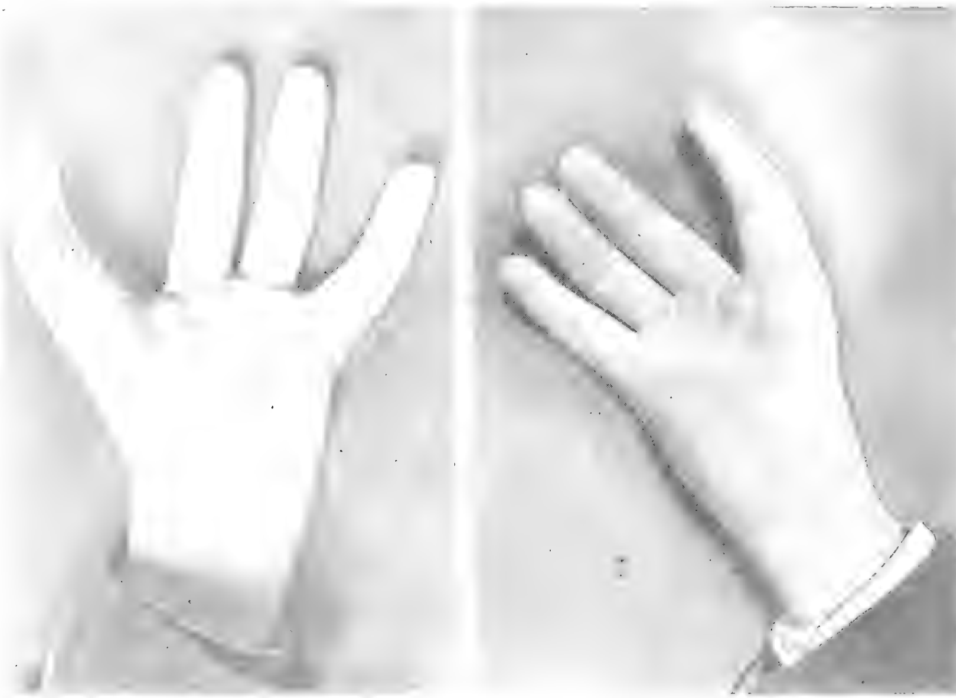
A FAMILY WITH ABNORMAL HANDS



The possessor of these hands recently arrived at Ellis Island, N. Y., where he was examined by Asst. Surg. Howard A. Knox of the United States Public Health Service. Inquiry showed that his father was normal; the paternal grandmother had webbed fingers on both hands, but the fingers involved could not be learned; a paternal male cousin had deformities exactly like those shown here, except for the rudimentary digit growing from the first finger of the left hand in this case; a sister of this cousin was described as an imbecile. The case well illustrates how a stock of rather low mentality is often characterized by physical defects, which are evidently due to heredity though not identical in each generation. Photograph from the United States Public Health Service. (Fig. 17.)

Inheritance of Fertility in Swine

Study of 3,540 litters of pigs is reported by Edward N. Wentworth and C. E. Aubel in the *Journal of Agricultural Research* (March 20, 1916). Previous studies had indicated that fecundity is to some extent an inherited character, although the degree of resemblance between parent and off-spring in this respect is not large. Cross-breeding has given some reason to suspect that a number of distinct, inheritable factors influence fecundity; it is also certain, of course, that fecundity is influenced by numerous factors which have nothing to do with heredity. The analysis of data showed some evidence of the presence of three distinct hereditary factors, but further research will be required before any result can be announced with confidence. The study is obviously an important one, in view of the great value of high fecundity in domesticated animals.

BREEDING NEPHROLEPIS FERNS

"Ever-Sporting" Types and the Methods of Propagating and Disseminating Them—New Forms May Be Obtained from Spores of Nephrolepis Ferns—Suggestions for Practical Growers

Sarkis Boshnakian

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FERNS of the genus Nephrolepis (of which the popular Boston fern is the best-known representative) can be divided in two groups, on the basis of their genetic behavior; first, those which show variation only when propagated sexually, by spores; and second, those which produce new varieties asexually.

The first group includes more than ninety species and varieties, all of which are either found growing wild in semitropical regions or have been produced from spores by breeders. Of these may be mentioned the widespread commercial varieties *Nephrolepis exaltata*, *cordata compacta*, *plumosa*, *davallioides*, *canaliculata*, and so on.

The second, and more interesting, group is limited to the Boston fern, botanically known as *Nephrolepis exaltata bostoniensis*, and all its sports, of which we have many.

In a state of nature, ferns are often hybrid. The sexual organs are located in such a position as almost wholly to prevent self-fertilization. The spores, found in large numbers as kidney-shaped, brown, fruiting bodies on the under side of the leaflets, produce occasionally new forms when sown. So far as results show, the ferns of the first group breed true when propagated asexually, and in England a large number of new varieties, such as concinia, and Mayi have been produced in this way from seedlings.

The ferns of the second group, that is those derived from the asexual variations of the Boston fern, may also be propagated from spores, despite the general belief that the spores are sterile. I have raised a number of seedlings from the spores of the Boston fern and of some of its sports; those with finely divided leaves produce no fruiting bodies, but the others with uncrested leaflets yield spores in abundance.

GERMINATION IS SLOW

It is considerably harder to grow the ferns of the second group than those of the first, or of other genera. The ferns of the first group with the exception of a few, such as *N. davallioides*, *N. d. furcans*, and perhaps some others, germinate promptly at the end of a certain number of days. *N. exaltata*, for instance, takes twenty-six days to germinate, and *N. plumosa* twenty-four; all the spores germinate at almost the same time. Such is not the case, however, with the Boston ferns. Out of thousands of spores, only a few may germinate at the end of a month or more; the rest keep appearing, a few at a time, for many months afterward.

They are very sensitive to the amount of moisture which surrounds them; and since nowhere, so far as I know, are directions given for germinating the spores of these plants, it may be useful for me to discuss the subject before proceeding to treat of the more usual, asexual method of propagation.

In an experiment to determine the best medium in which to sow Boston fern spores, different materials, such as loam, sawdust, paper pulp, filter paper, asbestos, cinders, cotton and leaf mold were used. The comparative efficiency of different containers was also tested. The results showed that the best medium was well-decayed oak-

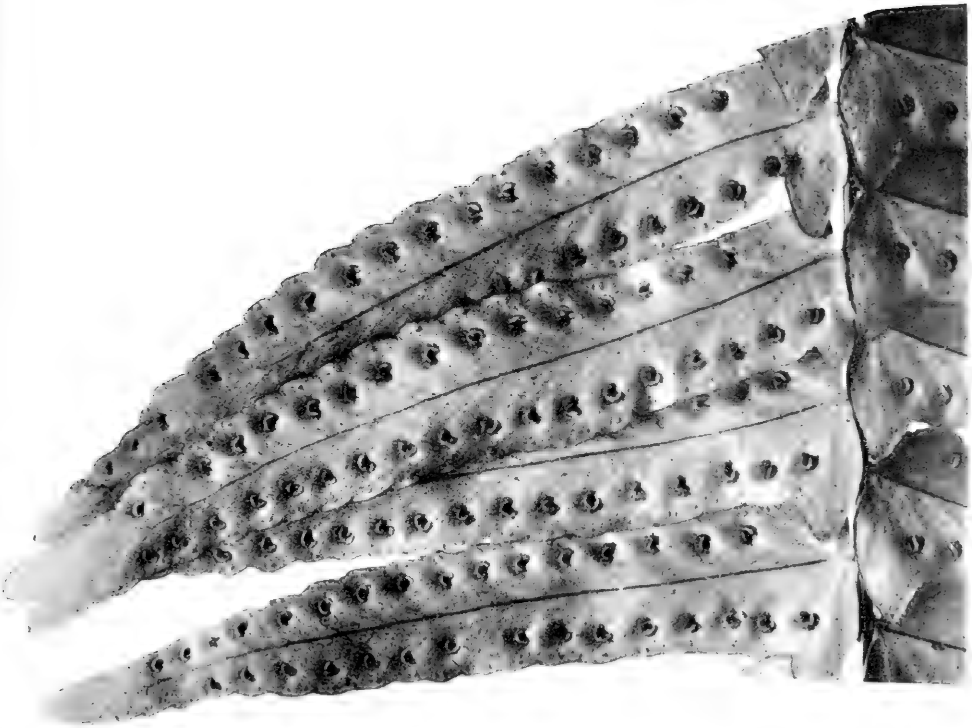
THE ORIGINAL BOSTON FERN

This fern, familiar to every plant-lover, has been particularly useful to breeders because it is constantly producing new forms—it is an "ever-sporting" variety. From this parent type sixty-five new varieties have been introduced to the trade, some of which have proved valuable and been retained, while others which were not of superior value in any one respect have disappeared. Probably the possibilities of the Boston fern are by no means exhausted, and it therefore offers an attractive material for amateurs as well as commercial breeders, since it can be propagated indoors, with little space, and there are no great difficulties to be overcome or expenses to be incurred. (Fig. 18.)

leaf mold. The advantage of this lay in its moisture absorbing and retaining property. The surface of leaf mold being uneven, the spores sown will fall on the projecting tips of the small pieces of leaf mold where the moisture hardly rises by capillarity but the spore is surrounded with a saturated moist atmosphere; they may also fall down in between the leaf particles where they come in contact with a microscopic film of moisture. All the intermediate conditions exist also, so that no matter what the moisture requirement of the spores, some of them will fall in a position where conditions are favorable.

As to containers, a clean pot not less than 6 inches in diameter seems to be the best suited for commercial work. For research work, where the exclusion of any foreign spore is necessary, the use of large preparation dishes with a depth of at least ¾-inch gives the best results.

The preparation of the medium in which to sow the spores differs also from that suggested for other ferns. The bottom of a clean pot of two-thirds



THE FERN'S REPRODUCTIVE ORGANS

The crescent-shaped masses found on the backs of many fern leaves are *sori* or aggregations of spore-cases. From a commercial viewpoint their presence is a drawback rather than an advantage—they are unsightly and not needed since in cultivation the fern is ordinarily propagated by runners rather than by spores. (Fig. 19.)

depth is filled to about 1½ inches in depth with clean broken crocks and large pieces of cinders. Over this, finely screened leaf mold is placed and is packed down somewhat firmly. The surface of the leaf mold should be about ¾-inch below the upper edge of the pot. The leaf mold should never be sterilized. Sterilization of the leaf mold is not desirable because with the cooking or baking of the leaves during the process of sterilization toxic substances are produced. This process also kills all living organisms, so that when spores of fungi or molds fall on the surface of this sterilized medium, they are absolutely free from competition, and they grow rapidly over the surface of the pot, either destroying the fern spore or giving off poisonous products which prevent the spore from germinating.

Since Nephrolepis ferns are not found wild in North America, leaf mold which the grower procures from the woods may be considered absolutely free from such spores. The pots are to be filled with this compost, and boiling water then poured over the contents, to kill grass seeds, worms and insects which may be present. Most of the seeds present will be destroyed after 20 minutes, and the surface of the leaf mold in the pot will then be almost sterile. As soon as it cools down, a little finely screened fresh leaf mold is scattered over it. The soil in the pot is thus inocculated with ordinary soil bacteria which grow very rapidly and spread over the surface; spores of fungi falling on a soil thus quickly populated with soil-bacteria will make a very small growth or none at all, but the germination of the fern spores is not interfered with in any way.

A GROUP OF SPORANGIA (SPORE-CASES)

Each of these capsules (here magnified about 100 times) contains a large number of ovoid spores, the reproductive cells, three of which can be seen in the upper left-hand corner. Although this method of reproduction is called sexual, the spores themselves have no sex—or rather, they are a combination of the two sexes in one. When they become ripe they are shed upon the ground, where they germinate and give rise to little sexual plants, called *prothalli*, shown in the next illustration. (Fig. 20.)

After the spores have been sown on the surface of this medium, the pot is covered with a piece of glass and then set in a saucer filled with water, in a partly shaded propagating frame. The saucers are placed on clean cinders over which lime has been scattered. This keeps away insects, worms and molds. At the end of four weeks or more the spores begin to germinate and form the so-called prothalli—heart-shaped, leaf-like plants which attain a diameter of a quarter of an inch, when fertile. From each of these develops a new fern. When the first leaves appear the prothalli should be removed in small clumps or singly with a pair of forceps and planted half an inch apart in flats or pans containing leaf mold to which a little finely sifted soil has been added. Later they are transferred into $2\frac{1}{4}$-inch pots.

The seedlings obtained in this manner are, as they grow, carefully watched for the appearance of new types, which are isolated and studied.

Most of our commercial varieties are sports of *N. exaltata bostoniensis*. This variety probably originated near Boston some thirty years ago. The first recorded sport of commercial importance occurred during the early part of 1898 and since then there have been produced over sixty-five commercial varieties of which about fifty are of American origin.

In order to produce new types it is necessary to raise a large number of

different varieties. This can be profitably practiced by persons who are engaged in growing ferns for commercial purposes, because they have under their observation a large number of plants which they are already growing for the market. The plants during their development are closely examined and those which show a tendency to differ in foliage or in habits of growth are isolated and grown directly in benches.

The somatic variations, such as are found among ferns, may occur in a portion of a frond, or on the stem or root stock, or on the runners. The only variations which are of any value to the breeder are those which can be isolated. Not all variations can be utilized.

WILL NOT GROW FROM CUTTINGS

There is no way of isolating a variation which occurs on a portion of a frond, for unlike some ferns and certain dicotyledonous plants, a portion of the leaf cannot be induced to strike roots to form an independent plant when brought directly in contact with soil.

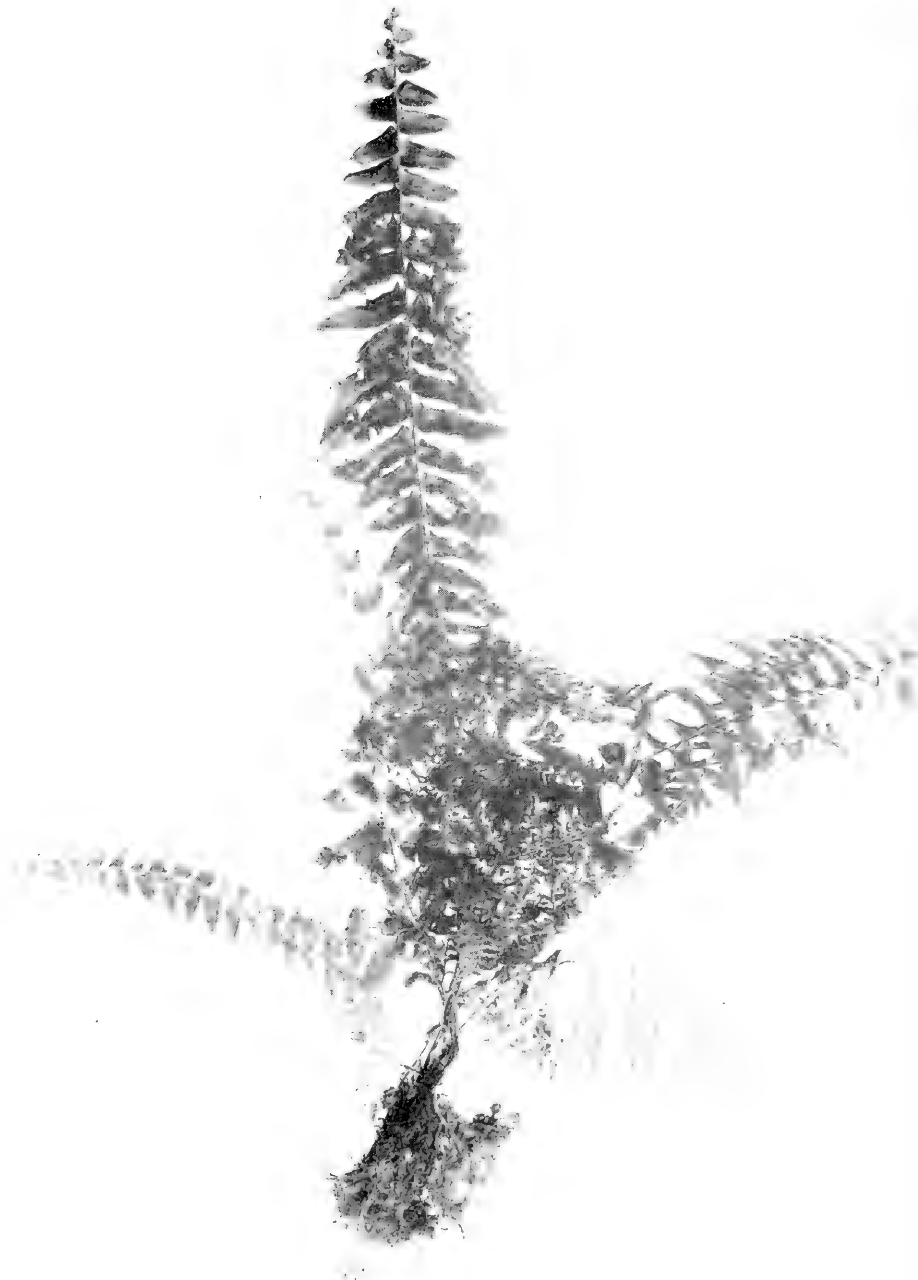
When the stem is above the level of the soil and an entire frond happens to differ from other fronds which arise from the same stem, the probabilities are that the variation or the somatic mutation, as it is sometimes called, has taken place on the stem. It is necessary to plant them deep enough to cover the base of the leaf which one wishes to isolate. Most of the old leaves are removed in order to allow the development of new fronds. If the variation has occurred in the stem it is likely that the new fronds arising from the base of the sporting leaf will resemble one another. On account of the depth at which the plant is set the base of these fronds including a portion of the crown will tend to strike roots.

It must be remembered that this is not a sure method of separating a sported plant. In order to obtain the expected result there are three conditions which must be satisfied. In the first place the sported portion must extend over a considerable area around the base of the rachis of the leaf (called the stipe); in the second place, from this region new fronds should develop which will be like the sported frond observed; and thirdly, this region must root in such a manner that it will develop into an independent plant which it will be possible to isolate from the mother plant.

FERN PROTHALLUS

This peculiar little plant (here magnified more than fifty times) grows from the fern spore and lies flat over the ground. It contains the male sexual cells (antheridia) at the region marked ♂, while there is a female reproductive cell or archegonium at the point marked ♀. When ripe, the antherzoids make their way towards the egg cell with which one of them unites. This fecundation starts the growth of a fan-shaped leaf-like structure, the base of which strikes roots and becomes an independent plant, whereupon the prothallus dies and decays. This indirect method of reproduction in the ferns is remarkable, ferns not giving rise directly to ferns, but rather to prothalli. (Fig. 21.)

For a sport of the second type, that is, when the variation takes place on a portion of the crown, the time it takes to satisfy these three conditions may vary from several months to a year or more, in some cases a negative result



IT REALLY IS AN "EVER-SPORTING" VARIETY

This Boston fern shows variations in size and shape of leaflets in every part of the plant. It is a curiosity to the geneticist, but almost worthless from the standpoint of the practical breeder, because these small variations will probably not "breed true." Frequently, however, a whole plant varies from its parent in some striking way; and such sports as that are perpetuated and form valuable new varieties. (Fig. 22.)

being a possibility. For this reason unless the variation is absolutely new it is not profitable to keep the plants very long and rely upon the law of chance.

SPORTS ON RUNNERS

The sports which are commercially utilized and which are easiest to isolate are those which appear on some portion of the runner where new rooted fronds are produced. When such a new type is discovered the entire plant with its runners is lifted from the bench, care being taken not to disturb the soil around the root system, and transplanted to a separate bench where the plant can be closely and frequently examined. The leaves of the mother plant near the sported fronds are cut back, for in this way more light is allowed to reach the new fronds and development of new buds is thus encouraged. It is a good plan not to sever the new fronds from the parent plant until the former has made about five leaves, for until that time the small fronds are nursed by the mother plant. At this stage the original plant may be removed by cutting the runner which connects the two plants. In order to produce more fronds and allow the rooting of runners a little soil is sifted over the plant to bury the crown. Some growers object to this method claiming that such a practice tends to produce decay at the base of the leaves, but after having practiced this method many times, and in some instances even after burying the crowns about an inch below the surface of the soil, I have never observed decay to take place; but on the contrary, in an experiment with *N. viridissima* to see the effect of deep planting I found more leaves on plants whose crowns were set one-half inch below the surface of the soil, than on plants which were not planted deep.

While the plant is developing in size the commercially desirable and undesirable characters as well should be studied, for it will be a waste of time and of valuable space to multiply a plant which is commercially worthless.

The following are the characters which are to be considered in determining the merit of a new fern:

The plant must be either an *improvement over another form* or be *a class by itself*. As we have already a good many types the chances are that the new sport will resemble some other variety; and unless it is an improvement over those already existing, the demand for it will be very slight. The improvement may not necessarily be in all characters, but no matter how few these improvements, they should be pronounced and striking enough to make the variety better than any already on the market. When *N. Piersoni* was being introduced in 1903 it received many prizes and was in great demand for some six years. It is now out of the market because other varieties with similar type of fronds, such as Whitmani and elegantissima with their "compacta" and "improved" forms, show such marked improvements in their habits of growth. But varieties like superbissima and its derivatives viridissima and muscosa being unlike other ferns cannot be compared with other forms; therefore, being a class by themselves, they have created a market of their own.

Those ferns are most profitable which can be raised to a marketable size in the shortest period of time. This period varies with the *rapidity of growth* of the plant. There are three growth characters which are desirable: in the first place the fronds should develop rapidly; in the second place numerous buds should arise in the central area of the plant to give it a dense form; and finally it should send out runners freely. The last character is especially important from the view point of the wholesale florist, as the latter is concerned mainly over the rapid propagation of the plant. Beauty and attractiveness alone without rapidity of growth do not make a new variety a commercial possibility. There are a few nephrolepis ferns which receive prizes wherever exhibited, but due to the fact that they are slow growers their sale is limited to private collections. On the other hand, ferns like bostoniensis and Scottii which originated

SOME DESCENDANTS OF THE ORIGINAL BOSTON

These leaves of modern commercial varieties show how widely some of the sports differ from their parent. Their trade names are as follows: *a, Nephrolepis viridissima; b, N. Millsii; c, N. muscosa; d, N. verona, e, N. magnifica; f, N. superbissima.* While these forms are relatively stable, they are all likely in turn to give rise to valuable new sports, from time to time. (Fig. 23.)

respectively about thirty and fifteen years ago, by virtue of their rapid propagating habit are still favorites. They are leading commercial varieties in spite of the presence of numerous competing sorts of recent introduction.

UNIFORMITY IS NECESSARY

Not less important is the *uniformity* of the size and shape of the smaller leaves known as pinnae. The plant should not show a tendency to "revert" or show any variation in any part of the leaves. Such a plant should not be allowed to appear on the market, for besides being a failure, it may sometimes affect the reputation of the firm which introduces it. In most cases it is possible to produce a pure-breeding strain by subsequent propagations by divisions. Some ten years ago, when few varieties existed, a number of them, such as Piersoni and Fosteri, in spite of their constant reverting habit were able to remain on the market for a number of years. But now that we have so many varieties, competition is very keen, and unless the plant proves to be a uniform breeder its introduction should not be allowed. From what has been said above, one should not be led to conclude that all commercial varieties will breed absolutely true. All of the sports of bostoniensis occasionally revert back to the original type in different degrees, and so far as I know this cannot be avoided entirely. For this reason the trade makes allowances for rare reversions. But plants which revert frequently find no place on the market.

Symmetry of the plant is another desirable character. Lack of symmetry is to some extent due to defective methods of potting, exposure to light, and careless overhead watering, yet in

THE APPEARANCE OF NEW VARIETIES

At the right (*b*) is *Nephrolepis magnifica*, a dwarf asexual descendant of the original Boston fern. *a* is a sport from this dwarf, and differs widely from its parent, particularly in showing greater vigor. It has one undesirable characteristic—namely, that its roots sport, and therefore it cannot be depended on to breed true. At *c* is shown a little frond sporting back to the mother (*b*) type. *d* is another root sport, not very different from the original Boston, but with the drawback that it is inconstant. By further division of this form *d*, a constant variety of value might be obtained. (Fig. 24.)

many cases the natural habit of growth of the variety is responsible for these defects. A variety with a rank growth of fronds is most likely to produce an unbalanced plant. Dense and bushy plants are least liable to lack symmetry. Multi-pinnate, that is, finely divided ferns, such as Smithii, and Goodii, unless they be large specimens, grow unsymmetrically. In these and similar varieties the defect is due to the weakness of the rachis of the leaves. The rachis can hold the frond upright so long as the latter is small; but when the fronds develop to full size they become heavy and hang down, spoiling the symmetry of the plant. A tri- or multi-pinnate fern with a heavier rachis that can support the weight of the developed frond will create a ready market. A sport of Smithi recently introduced under the name of *N. verona* seems to possess this desirable character and its outlook is promising.

Sori or masses of spores on the underside of the leaves are objectionable, because they form undesirable brown spots of considerable size; and furthermore when these ripen, the spores fall on the surface of the leaves below giving them a rusty appearance. Ferns with finely divided leaves, and young plants plants with undivided leaves, are free from spores, but the latter in most cases begin to produce spores when they get old.

On account of lack of air circulation at the base of the plant, in some forms

A DELICATELY GRACEFUL VARIETY

The descendants of the Boston fern differ widely (as was shown in Fig. 23) in the extent to which their leaflets are divided. The form here shown, *Nephrolepis Smithii*, is the most finely divided of all the commercial varieties, and therefore possesses an appearance of lightness and airiness which has made it a great favorite. (Fig. 25.)

compactness of foliage causes decay of the center of the plant. This is especially evident in those varieties whose leaflets are very thickly set on the rachis. Such forms, if possible, should have an *open center*.

When the originator is convinced that his plant conforms with the desirable characters just discussed he should begin to increase its numbers. This is best done by planting the fern in a bench and allowing plenty of space around it for the runners to radiate in all directions. These runners, like those of the strawberry plants, root at intervals and give rise to new small plants which can be easily severed after they have made five or more leaves. These little plants are first potted in small pots; in late spring or early summer these are again planted in benches where they are allowed to develop and produce runners. The new plants arising from these are severed in the same manner as before, and the practice is repeated until the desired number of plants for introduction are obtained.

INTRODUCING A NEW VARIETY

The success that the new variety will have on the market will depend entirely upon the proper methods of introduction. There are many instances where a certain variety has been sold on a very large scale although there has been a similar variety already on the market; but because of lack of proper methods of introduction the latter has had little more than a local sale.

Since this paper has been prepared primarily for the practical breeder, it will not be out of place to give in conclusion brief suggestions of the best procedures which should be followed in the introduction of new varieties of ferns.

The number of the plants which the originator should have on hand before introducing depends entirely upon the degree of his ability to dispose of the plants and upon the excellence of the variety itself. For a good variety, from 5,000 to 30,000 plants and even more will be necessary. Depending upon the ease with which the runners root it takes from three to four years to obtain them. The first customers are usually the wholesale growers of ferns who buy the plants in order to produce larger ones after growing them for some time. They offer them to the market while the supply is still limited. The originator must naturally have enough on hand to supply these growers and to keep on supplying ferns while the latter are developing their stock of plants. The minimum time required for growers to put their stock on the market is probably six months. During this period the introducer may have a monopoly on the stock, and being free from competition can hold his price high.

If, due to the lack of necessary greenhouse space, the grower cannot multiply his plant to the desired number, he will find it profitable to communicate with one or more large wholesale growers who will agree to raise part of the stock and return a certain percentage of the profit from the sales. There are, of course, many other agreements which can be made. In the case of *N. Amerpohlii*, for instance, part of the stock was shipped from Janesville, Wis., where it originated, to two wholesale growers in Philadelphia. When the stock had been increased, it was offered for sale simultaneously by these three firms.

It will usually be found profitable to disseminate a new variety of fern in spring. When some of the greenhouses, especially carnation houses, are vacant during late spring and summer months, the benches can be profitably utilized for the growing of ferns. It is not necessary to change the soil for these plants. Violet houses are also excellent for ferns in summer. The runners root before the benches are needed for the regular crop. These rooted runners may be potted in 2¼-inch pots. By the following spring they develop good sized plants. Another advantage of spring dissemination is the opportunity of exhibiting specimen plants at the fall flower shows.

As wholesale buyers are very critical about a new plant which has not yet stood the test of time, no effort should

be spared in showing all its merits. It is advisable not to begin to advertise until three or four months before the time set for dissemination, or a few weeks before some important flower show, so that those interested may eagerly look for the new plant at the exhibitions. If it is advertised too early people are apt to forget about it by the time it is to be introduced.

Skillful and attractive methods used in advertisements and displays will almost entirely determine the reception and success of a newly introduced fern.

Genetics in Education

One hundred colleges or universities in the United States are giving courses specifically in either eugenics or genetics during the present school year, according to a census made by the *Eugenical News*. This list does not include the agricultural colleges, which present much of the same material in their courses on breeding.

Unusual Fecundity in a Cow

A remarkable case of fecundity in a half-blood Hereford is reported by E. C. Wetherbee, Jr., of Marshalltown, Iowa, a member of this Association. The cow, which belongs to William Harkemeyer of Benton County, was herself a twin, born in June, 1909. In December, 1911, she dropped two calves; December, 1912, one calf; January, 1914, two calves, and December, 1915, three calves.

Feebleminded Adrift

There are about 15,000 feeble-minded in Massachusetts, of whom 3,000 are now receiving State care, according to the League for Preventive Work (Boston) which has just published a booklet with the title "Feebleminded Adrift." Of the 12,000 for whom no State provision is made, many are protected in good homes. Another group are sexually passive, industrially competent, and capable of adjusting themselves to community standards. For neither class, it is declared, is State segregation necessary or desirable. Approximately 2,000, however, can always be found in other public institutions. Those committed to insane hospitals are usually held in permanent custody; the others drift in and out of almshouses, prisons and reformatories. These 2,000, therefore, a constantly shifting group, represent many thousand unprotected feebleminded in the community, for whom custodial care is essential.

The development of State schools for the segregation of the feebleminded, it is pointed out, meets the requirements of economy, justice and efficiency. Their per capita cost for maintenance is less than that of other institutions. They furnish a simple environment which is adapted to the needs of defectives and which enables them to live happily on their own plane. They offer specialized industrial training which renders many of the inmates wholly or partly self-supporting within the institution, transforming them from demoralizing and destructive forces into productive members of the State. They furnish protection both to Society and to the feebleminded for whom community life means danger and exploitation. And finally, by permanent segregation, they prevent the procreation of a new generation of defectives, thus cutting off at the source one of the greatest of social ills and striking at the root of the physical and moral degeneracy, pauperism and misery, alcoholism and crime, with which feeblemindedness is inevitably linked.

The Massachusetts State Legislature of 1915 appropriated $50,000 for the purchase of 880 acres of farm land near Belchertown, in the western part of the State, and it is hoped that the present legislature will appropriate $150,000 annually for five years, for the construction of buildings to house 1,000 inmates.

EUGENIC SURVEY OF NASSAU COUNTY, NEW YORK

BY A GIFT of $10,000, the Rockefeller Foundation has made possible the immediate beginning of a eugenic survey of Nassau County (Long Island), N. Y. It will particularly attempt to find the amount of mental deficiency existing.

During recent years, the burden of caring for defectives has in many States become almost crushing. New York is now spending more for the insane alone than for any other purpose except education, the amount being about one-fifth of the State's total revenue. Massachusetts is spending one-third of her entire income on the support of those who require state care. In many other States the problem is rapidly reaching similar proportions.

The growing recognition that many—perhaps the greater part—of these defectives are the product of defective heredity, has brought a realization that the stream can, without much difficulty, be greatly diminished at its source.

The first requisite is to know the facts in regard to the distribution of defect in an unselected population. Hitherto, studies have been made largely in institutions, and there has been no comprehensive study of an ordinary population. Nassau County, with a population of about 100,000 in a rather small area, divided between farms and towns, seems to offer a good opportunity for ascertaining the conditions in a community that is probably fairly typical of a great many in America, and some of its residents have been public-spirited enough to undertake the work of making as accurate as possible an estimate of the number and kinds of mental defectives at large, in order that the State may better be in a position to consider what the situation demands. It is well known that the number of defectives now receiving State care is only a part of the number which ought to receive such care; but no one knows what proportion. The Nassau County survey will help to answer this question for the State of New York, and to a less extent for other eastern States.

MENTAL TESTS TO BE USED

The first step will be to select for special examination all those children and adults who are known to the educational, poor-law, police or health authorities as having failed to hold a normal place in the community either by reason of unteachableness, or moral deficiency, or imperfect social adaptation. This will mean the examination of backward, atypical or unruly children in schools, children and adults in almhouses and other institutions, inmates of prisons and others known to the police, children and adults in receipt of outdoor relief, persons known to the medical profession or others as being possibly defective.

The examination of these people will consist of an inquiry into the family, social, and personal history, and a series of mental tests.

But the collection of data regarding these abnormal persons would possess little value, unless at the same time data were secured about the normal individual living in the same environment. The survey will, therefore, undertake to secure information about *every one* in certain selected districts. The information about those who are apparently normal will not be so full as about those who are apparently defective; but there will be an endeavor to get a certain minimum amount of information about each one, which would establish his normal mentality and would make possible eventually the construction of normal statistical social standards for the county, pertaining to the facts of heredity, progress at school, and amount of education, occupations and earnings,

social position, civil condition, fertility, and physical health.

The labor, therefore, will consist of the examination of selected persons in all parts of the county and all persons in selected parts of the county. It is estimated that this will take at least four months, and that several months more will be required for working up the data. The State of New York has furnished the services of Dr. A. J. Rosanoff, of King's Park Hospital, to direct the survey; with him will be one or more medical examiners furnished by the United States Public Health Service, eight field workers to investigate the family histories of the individuals examined, and several clerical assistants. Headquarters will be at Mineola, the county-seat.

General direction of the survey will be in the hands of a committee, consisting of Dr. Charles B. Davenport, chairman: Samuel P. Duggan, Elizabeth E. Farrell, Homer Folks, Dr. August Hoch, Dr. A. J. Rosanoff, and Dr. Thomas W. Salmon. The survey was initiated and will be partly financed by the Nassau County Association, a citizens' organization which has hitherto taken an active interest in the problems of eugenics and cacogenics in its district.

Genetic Survey of Kansas City

"The Southwest School of Hygiene of Kansas City, Mo., under the directorship of Dr. Belle S. Mooney, is organizing a Eugenic Survey of the city with the cooperation of the Board of Education," says the February *Eugenical News*. "The plan is to secure the family history of all the school children and not simply the history of the backward children. This is an important step in the right direction. No class of society can be rightly studied apart from its fellows. Our studies of human heredity have thus far been too one-sided." This will make a valuable check on the Nassau survey.

Nebraska Sterilization Law

Sterilization of feebleminded and insane is provided by a law passed by the 1915 session of the Nebraska legislature. It provides that all inmates of state institutions for the feebleminded and insane, the penitentiary, reformatory, industrial home and schools, and other state institutions, who are subject to parole or discharge, shall be examined by a board of five physicians, who shall inquire into the "innate traits, the mental and physical conditions, the personal records, and the family traits and histories." If they find that children of the individual would probably inherit a tendency to feeblemindedness, insanity, or degeneracy, he shall not be given his liberty unless he is sterilized by such an operation as the board of physicians may indicate. The consent of his family and of himself, if possible, must first be obtained.

The Drama in the Service of Eugenics

The "eugenic plays" hitherto presented have been, in general, presentations of negative eugenics and sex-hygiene, and have generally merited the description of unpleasant plays. The Eugenics Section of the Pittsburgh Academy of Science and Art believed that a pleasant play dealing with positive eugenics would be a valuable piece of propaganda. Through its dramatic committee it discovered the value of George Middleton's "The Unborn," and this was recently presented in the Northside Carnegie Lecture Hall. The impression it made was so evident that it is to be repeated on May 2 in another part of the city, and possibly in some other Pennsylvania cities. The performance was made possible by the cooperation of the Little Theater Company, an amateur organization of Pittsburgh. The play, which lasts only twenty minutes and deals with voluntary childlessness, was followed by a spirited discussion.

THE LATEST "SIAMESE TWINS" ON RECORD

Suzanne and Madeleine Durand, born in Paris on November 28, 1913, were joined face to face by a band of hard flesh about a foot in circumference, near the bottom of the breast bone. The two abdominal cavities were in communication through this hollow link, and the small intestines of one girl could be drawn through the link into the other girl by the mere act of breathing, provided one let out her breath while the other drew in hers. The vital organs of the two were complete and separate, however. The twins were separated by Dr. Gustave Le Filliatre on March 4, 1914, and at last reports were growing healthily. The photograph shows them with their nurse, before they had been cut apart. This is said to be the ninth operation of the kind on record. Such twins as these give support to the idea that so-called "identical" twins are the product of a single egg. Photograph from Paul Thompson. (Fig. 3.)

Prizes for Eugenic Studies

A committee on promotion of the ideal of racial well-being created by the National Council of Education announces that a fund of $1,000 for each of four years has been offered by an anonymous donor. A prize of $100 is open to graduate classes of two-year normal courses in each of four sections of the country. Similarly a prize of $150 to members of graduating classes of colleges and universities in the same sections who have had two years of work in education or home economics. The prize is awarded to the class that makes the best cooperative study on the topic, "The supreme object of education should be to make the next generation better than living generations." The first prizes will be awarded to the class of 1917. Notice of intention to compete should be sent before May 1, 1916, to Dr. H. C. Putnam, Rhode Island Avenue, Providence, R. I., of whom further details can be obtained.—*Eugenical News.*

Defectives in District of Columbia

There are few states which have made less provision for mental defectives than has the Federal Government, and at the present time practically all the feeble-minded, some hundreds in number, in the District of Columbia are allowed at large without any restraint or oversight. Representative Tinkham of Massachusetts has introduced a bill (H. R. 13666) into Congress providing for an institution for the feeble-minded in the District of Columbia, appropriating $500,000 for it and outlining a method of commitment. The measure is receiving the active support of the Committee on Provision for the Feeble-minded (Philadelphia), and deserves the assistance of every one who is interested in proper care for the defective classes in the nation.

The

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EXAMINING IMMIGRANTS AT ELLIS ISLAND, NEW YORK

Surgeons of the United States Public Health Service test every immigrant, physically and mentally, in order to send back any who give promise of being undesirable additions to the population. New legislation, however, is much needed, to make this examination more thorough, and to exclude certain undesirable classes which the present law admits. The above photograph, from the United States Public Health Service, shows how the physical examination of aliens is conducted. The boy under the measuring bar, in the foreground, and the three immediately to the left of the desk, are examples of congenital asthenia and poor physique; two of the four were found none too bright mentally. (Frontispiece.)

WAR, IMMIGRATION, EUGENICS

Third Report of the Committee on Immigration, American Genetic Association

Alexander E. Cance, Amherst, Mass.
Irving Fisher, New Haven, Conn.
Prescott F. Hall, Boston, Mass., *Chairman*
Robert DeC. Ward, Cambridge, Mass., *Secretary*

THE Committee on Immigration of the American Genetic Association herewith submits its third report. There is one vacancy in the membership of the committee, Prof. James A. Field having resigned.

A crisis has been reached in our immigration policy. The war has, for the moment, very largely reduced the flow of aliens to our shores. For the first time in many decades we have breathing space. On the other hand, the effects of the war upon the peoples from which our future immigration will come are likely to be far-reaching. This fact will, after the war is over, bring us face to face with many new and difficult problems which need careful consideration at the present time. We must think clearly, decide wisely and act quickly. We need new immigration legislation. We need it at once.

There are two aspects of immigration after the war which concern us at this moment. One is the probable future volume of immigration. The other is its probable mental and physical character.

The demoralization of industry; the breaking-up of homes; the greatly increased burdens of taxation; the desire to fly from the horrors of future wars; the widespread misery and hopelessness; the return to the United States of aliens who went home to fight and who will bring back with them many of their countrymen who have never been here—these and other causes will operate to bring us an increase in immigration which seems likely to surpass anything that we have ever known. Already plans are being made by foreign companies for the establishment of new steamship lines to bring emigrants from Europe and Asia to the United States as soon as the war is over. Prof. J. W. Jenks has pointed out that recent wars have usually resulted in a large and almost immediate increase in emigration from the European countries which were at war.

WHY MANY WILL NOT COME

On the other hand, there will be tendencies which may operate to cut down emigration from certain European countries. An enormous amount of constructive work will have to be done in the general rehabilitation of what the war will have damaged or destroyed. Immense numbers of skilled and also of unskilled workmen will be needed for these enterprises. Owing to the thinning of the ranks of the most efficient laborers, by death or by injury, during the war, wages of some classes of workmen may rise, but whether the impoverished nations of Europe will be able to compete in any general way with our American wages, and thus keep their people at home, yet remains to be seen. Again, it is not unlikely that some of the European governments will take steps to discourage, to check, perhaps even for a time to prohibit emigration. The work of reconstruction will go on most actively and most effectively in the countries of northern and western Europe, where the state and industry are well organized, and where the plans for reorganization will be carefully prepared. It is, therefore, from these same countries, from which we have in the past received our all-round "best" immigrants, that we are likely to see the greatest falling off in immigration. On the other hand, in the countries of southern and eastern Europe and of

western Asia, immigration from which has been on the whole more of a problem, because of the differences in race, political institutions, education and social habits, there will not be the same organized reconstructive work. From these countries, therefore, so largely in the more primitive condition of agriculture, the forces tending to promote emigration will be operative to a greater degree than before. Thus the great preponderance of southern and eastern Europeans, already the most striking feature in our recent immigration, is likely to be still further increased after the war is over. Balancing the reasons for a possible decrease in our immigration after the war against those which will bring about an increase, the weight of probability is strongly on the side of a marked increase.

INCREASE OF DISEASE

No one who has at heart the future of the American race can fail to view with concern the probable effects of the war upon the physical and mental condition of our immigrants. The introduction of pestilential war diseases, such as cholera, typhus, typhoid fever and the like, is not greatly to be feared, although some of our medical men are already viewing this problem with much concern. On the other hand, the more subtle and much less easily detected venereal diseases, which are always rampant in great armies in war time, and the mental breakdowns, of which there are so many thousands of cases among the soldiers at the front, present another aspect of the health problem which is far more serious.

The final report of Lord Sydenham's Royal Commission on Social Diseases (cable summary, March 2, 1916) dwells particularly upon the effect of the war upon the prevalence of venereal disease, and looks for a far more serious condition of this problem after the war is over.

Great numbers of soldiers, although not actually afflicted with any specific disease, will eventually come to the United States, maimed, crippled, wounded, enfeebled by illness or exposure, or mentally unstable. The fittest, mentally and physically; those who in the past have had the initiative and the courage to emigrate, will be dead, at the prime of life, or will be needed at home to carry on the work of rebuilding and reorganization. These are the men whom Europe will do its utmost to keep at home. The least fit are most likely to emigrate. Many of those who, because of mental or physical disability, will find themselves least able to earn a living abroad, will be the very ones most likely to be "assisted" by relatives and friends in this country to "come to America." Against the emigration of such persons the European governments will not set up any barriers. There are good grounds, therefore, for expecting, with reasonable certainty, that our immigration in the next few decades after the war will be of a lower physical and mental standard than it has been in the past.

WAR AND THE BREED

The question as to the probable effects of the war in the more distant future, upon the unborn generations, is obviously a difficult one. Opinions vary greatly in regard to it. As a rather extreme representative of one side, one may turn to Dr. David Starr Jordan's latest book, whose title clearly indicates the message which its author seeks to bring, "War and the Breed: the Relation of War to the Downfall of Nations" (1915). War, as Dr. Jordan strikingly puts it, "impoverishes the breed." The strongest and best men are the ones who are killed or injured, and who leave few or no children. The weaklings live, marry and continue the race. The result is an inevitable impoverishment of the stock. Dr. Jordan notes the reduction in the required height of French soldiers as the result of the Napoleonic wars and the killing off and wounding of the taller men. The French and German babies of 1870–71, who came to be mustered as soldiers twenty years later, were found to be an inferior lot of men. And, more recently, as noted by Dr. Jordan in *Science* (New York), a similar condition has occurred in Japan. The Japanese

children born at the time of the war between China and Japan, twenty years ago, became conscripts in 1915. According to the *Asahi* of Tokyo, as translated in the Japan *Chronicle*, the number of conscripts in Tokyo decreased over 16%. For Japan as a whole there was an increase of conscripts in 1915, but the rate of increase was only 30 to 50% of the normal. Furthermore, a lowering in the quality of the new soldiers is distinctly observable. The *Asahi* says that "most of those who underwent conscript examinations this year were born during the war and therefore are sons of those too old or too weak to go to the front, and so it is no surprising thing if the conscripts of 1915 are of exceptionally delicate constitution." This "impoverishment of the breed," in Dr. Jordan's opinion, is an inevitable result of war. The longer the conflict continues, the more serious will be the effects upon future generations. The weakling fathers—too young, too old, or too feeble to fight—and the improperly nourished, overworked and harassed mothers of Europe are handing on to their children who are now being born an inheritance of physical and mental unfitness which will mark not only this generation but future generations, through the long vista of the time to come. An increase in the number of defective children, now and hereafter, is a condition which Europe must face, and which, because it will affect the character of our immigrants, vitally concerns the United States. Dr. Ales Hrdlicka, of the Smithsonian Institution, contributes to Dr. Jordan's book an opinion as to the probable effects of heavy artillery firing on the nervous systems of soldiers in the war. He believes that subjection to the constant roar of the firing will "result in a more or less defective mental or nervous state in the progeny of such individuals."

SOME COUNTERBALANCES

Dr. Jordan's view may be thought rather extreme. The problem is a highly complex one. There are not lacking those who take a different position. It is pointed out that wars have been so constant, not only in Europe but over most of the world, that if wars do result in racial deterioration, national degeneracy should have followed them. Again, it is urged that by no means all of the physically and mentally fit who go to war are killed, or are so impaired in body or mind as to be undesirable fathers for future generations of offspring. The number and the quality of the men who will survive the war is at present an unknown and indeterminable element in the problem. Prof. Roswell H. Johnson, of the University of Pittsburgh, has recently warned us[1] against sweeping and unqualified statements that war is either good or bad in its effects on the human race. Some wars are mainly good, others mainly bad. A conscripted army is likely to be physically, and probably also in other respects, superior to the bulk of the population. The conditions of poverty, improper sanitation, and inadequate medical treatment in the homes tend toward a deterioration of the race. Many factors must thus be taken into account. In summing up his argument, Prof. Johnson says:

"In the present war it would seem that the high quality of both sides compared with the rest of the world is so predominant a dysgenic factor that, together with the other dysgenic features, the eugenic results are overbalanced. The human species therefore, on account of this, is at present declining in inherent quality faster than in any previous length of time."

In connection with this particular subject, it is highly significant that Germany, which is universally recognized as preeminently the military power of the world, and whose scientific study of military problems is so thoroughly organized, should already be giving serious attention to the racial effects of the war. On October 26–28, 1915, there was held in Berlin, a *Tagung für die Erhaltung und Mehrung der deutschen Volkskraft*—surely a highly significant designation. Over 1,000 delegates attended, and the proceedings were marked by an extraordinary unanimity of sentiment. It was recognized that "war kills the best, the bravest, the

[1] Journal of Heredity, Vol. VI, No. 12, December, 1915.

healthiest, eradicating once for all the finest strains of the race." There was serious discussion with a view to bringing about an increased multiplication of the fit by various means, chiefly the assistance of large families of healthy stock.

From the foregoing considerations it appears that the effect of the Great War upon the United States will, unless all signs fail, be profound and far-reaching. For it will affect the mental, physical and even moral characteristics of millions of our future immigrants and of their descendants.

PROPOSED LEGISLATION

There is a bill which passed the House of Representatives on March 30, 1916, by a vote of 308 to 87 (H. R. 10384), which, all things considered, is the most comprehensive immigration bill ever introduced into Congress. It is the result of years of careful study of our present law and of its workings. Its provisions, as the commissioner-general of immigration says in his last annual report (June 30, 1915), "contain the result of experience and investigation—of the experience of administrative officers, extending over nearly a quarter of a century, in the enforcement of various statutes regulating immigration, and of the investigations conducted variously but in particular by the Immigration Commission, created under the act of 1907, the report of which, comprising forty-two volumes, was submitted to Congress in December, 1910." The provisions of this bill "have been drawn with great care and thoughtfulness, . . . by them the law is made certain in its definitions and clear in its terms throughout—improvements badly needed in the existing statute." The bill aims to protect the United States against the incoming of mentally and physically, and of otherwise unfit and undesirable aliens. It also embodies several provisions which would insure more humane treatment to the aliens themselves, and would, to a large extent, do away with the hardships involved in the deportation of aliens who are excluded at our ports, by preventing their original embarkation.

The bill is largely a codification of our existing immigration laws, but embodies several important new eugenic provisions. Attention is here called to the more important changes which its enactment would make in our present laws with reference to the exclusion of the mentally and physically unfit. In regard to the better detection, exclusion and deportation of this group there is no essential difference of opinion among those who have the future of our race at heart. The unanimity of feeling in this matter is encouraging; but, in view of our past experience with mentally and physically defective aliens who have been admitted to this country, it is not surprising.

MORE STRINGENT MEASURES

To the excluded classes the bill adds *persons of constitutional psychopathic inferiority* and *persons with chronic alcoholism*. That many persons not properly to be certified as insane but who would, in many cases, become insane soon after arrival, could be kept out under the former provision, has long been the opinion of the physicians, the alienists and the immigration officials who have made a special study of this subject, and who have for years strongly urged the inclusion of this new provision in our immigration law. Chronic alcoholics, who are surely undesirable members of our community, are often discovered by our examining surgeons, but as the law does not now state specifically that they shall be excluded they must in most cases be allowed to land. The new bill excludes *vagrants*, and *persons afflicted with tuberculosis in any form*. It also aims to prevent the embarkation of aliens afflicted with idiocy, insanity, imbecility, feeblemindedness, epilepsy, constitutional psychopathic inferiority, chronic alcoholism, tuberculosis in any form, or a loathsome or dangerous contagious disease, by imposing upon steamship companies who bring such aliens a fine of $200 plus the amount paid by the excluded alien from his initial point of departure, provided the Secretary of Labor is satisfied that the defects could have been detected by a competent medical exami-

nation before embarkation. This is an excellent and humane provision. It would go far toward making these companies more careful in the sale of passage tickets, and would save many unfortunate aliens the disappointment and hardship of being deported after arrival at our ports. The present fine is $100, has been shown to be too small to be really effective, and does not cover as many cases as are above enumerated. A new fine of $25, plus the alien's transportation expenses, is established in cases of certain other less serious mental defects, and of physical defects which may affect an alien's ability to earn his living.

BETTER EXAMINATION

The new bill provides for a very much more thorough medical examination of arriving aliens, especially with reference to the detection of mental disease; gives the medical inspectors the exclusive services of interpreters, and suitable facilities for the detention and examination of the aliens. This amendment has been strongly urged by the united action of the most important scientific bodies in the United States which deal with the prevention and treatment of mental disease; by state medical associations, and by individual physicians all over the country. That our medical inspection has been hopelessly inadequate has long been known to the experts. We have not had enough medical inspectors, and those on duty have not had adequate facilities for their work. Thus it has come about that in spite of our law prohibiting the admission of insane and mentally defective aliens, our institutions have been filling up with just these people. As Dr. T. W. Salmon, of the National Committee for Mental Hygiene, has well said:

"There is no reason for the acceptance of a single insane or mentally undesirable alien except inability to determine his condition."

It is a very significant fact that, with the decrease in immigration since the war, particularly at New York, a more rigid medical inspection has become possible. This "intensive examination" has resulted in a marked increase in the numbers of aliens certified as having physical or mental defects. It has also resulted in increasing the percentage of the total arrivals who were debarred or returned within three years after landing from 2.6% in 1914 to 6.1% in 1915. "Certainly," says the commissioner-general, "there could be no better or more convincing argument . . . for increasing the medical force sufficiently to insure that no alien shall be admitted to the country until he has been subjected to a medical inspection really calculated to disclose his mental or physical deficiencies." With this statement all public-spirited citizens will surely agree.

The new bill extends from three to five years the period during which aliens may be deported who at the time of entry belonged to one or more of the excluded classes; who have become public charges from causes existing prior to landing; and of some other groups. This extension of the deportation period has been urged, year in and year out, by heads of institutions who have had to do with dependent, defective and delinquent aliens; by organized charitable societies, and perhaps most strongly by the former commissioner of immigration at the port of New York, Hon. Wm. Williams, whose thorough, sane and illuminating study of the whole immigration problem has contributed greatly to our understanding of the subject. It is the conviction of all the unprejudiced experts who have studied this problem that a five-year deportation period would relieve our penal and charitable institutions of an enormous financial burden, reaching into the millions of dollars, and would rid our communities of large numbers of defectives who otherwise would remain here, many of them a burden upon State or city, and many of them starting long lines of defective and delinquent children.

SAFEGUARDS FOR THE ALIEN

The new bill strengthens the provisions of existing law regarding the "White Slave" traffic; makes the inspection of steerage quarters more thorough; compels steamship companies, when

deporting aliens, to give such aliens as good quarters as those for which they paid on the voyage to this country; makes possible the expulsion from the country of alien anarchists and criminals, even when they have become such after entry; and in many other ways provides for the welfare of the alien as well as for the welfare of the United States.

All these new provisions regarding the more effective exclusion and the deportation of mentally and physically unfit aliens have been carefully drawn, as above stated, after consultation with experts who have seriously studied these particular aspects of our immigration problem. They were all suggested and strongly urged upon Congress years before the war broke out. Their enactment into law should have been effected long ago, under the usual conditions of normal immigration. But every argument in favor of this legislation has gained weight, incalculably, in view of the probable effects of the war upon the character of our future immigrants. As the commissioner-general says in his last annual report, the adoption of these amendments now "becomes an imperative necessity." It is for the best interests of our future race; it is for the best interests, in the long run, of humanity at large, to prevent, as far as may be possible, the coming to this country of the mental and physical derelicts of the war. It is unfair and ungenerous to future generations of Americans to saddle upon them the tremendous burden of supporting, not only the present generation of these people, but the long lines of their descendants. It is not doing our share in the promotion of race betterment if we, who have the matter in our own hands today, do not act at once, before it is too late.

The Committee on Immigration of the American Genetic Association heartily endorses the provisions of the pending bill which are directed towards the more effective detection, exclusion and deportation of mentally and physically unfit immigrants, and urges upon the officers and members of the American Genetic Association to make every possible effort to secure favorable action by the Senate upon this bill.

What Becomes of the "Special Class" Children?

Eugenicists have often pointed out that the costly "special classes" in public schools, for the education of pupils who are distinctly backward, are founded largely on ignorance; that many of the pupils in them are feebleminded and can never be brought up to the level of the normal child, or given effective education of the usual kind. It is therefore interesting to note the results of an investigation made by the school department of Detroit, Mich., of the records of 100 pupils from the "special classes" who had left school at 16 years of age, and who had in no case been out longer than five years. Of the 100 cases, 61 were boys and 39 girls. Their present status, summarized, is as follows:

	Girls	*Boys*
Number of children born	3	0
Married	5	0
Sexually immoral	14	0
Working	16	39
Cared for at home	15	11
In institutions	1	5
Have been arrested	4	13
Dead	1	2
No information	6	4
NUMBER OF JOBS		
None	11	12
One	9	11
Two or three	2	9
Three or more	5	23

Of the children born, two are illegitimate of known feebleminded mothers.

The eugenicists' contention that defective children require segregation instead of "special classes" appears to get a good deal of support from the above record.

EUGENICS AND AGRICULTURE

City Life Sterilizing Best Lines of Descent on a Large Scale—Population Must be Held on the Farm if the Race is to Improve—Proper Appreciation of Rural Life the Greatest Influence for Eugenics

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NOBODY questions seriously the desirability of eugenics, of taking thought for the preservation and improvement of the human race. But many doubt the advantage of measures that are being proposed under the guise of eugenics. Too much hen-roost and barnyard tends to disgust, rather than to convince the public of the utility of eugenic effort. To mate for eye-color, or to sterilize a few criminals, or to scare the responsible part of the community from marriage because of some trifling ancestral defect, do not strike reasonable people as very important steps toward the attainment of the constructive ideals of eugenics.

From a really constructive point of view we would see that much more important issues need our attention, that the preservation of the best is much more vital than the elimination of the worst. Galton and others of the more profound students of the subject have perceived this clearly but they have stopped with suggestions of subsidies for desirable marriages, or bounties for large families of desirable children, measures that are not likely to appeal very strongly to the desirable people.

To set one's self up and claim a subsidy, or to be set upon and subsidized, would be almost as annoying to a really desirable citizen as to be cast out and persecuted, which is one way to drive reformations forward. Socrates and Jesus were not only condemned but executed as undesirables. The Greeks did not follow up their persecution as efficiently as the Jews, and the disciples of Socrates were not fused into a religious community like the early Christians.

Obviously we are not yet competent to undertake the responsibility of fostering special classes or varieties of the human race, of separating the tares from the wheat. There are many kinds of wheat, and many of tares. Some of the wheat is weak and sterile and some of the tares may become valuable. Man shall not live by wheat alone.

THE IMPORTANCE OF AGRICULTURE

Vastly more important than any of the premature and doubtful issues commonly discussed as eugenics, is the relation of agriculture to the well-being of the race. A wholesale elimination of choice lines of descent is going on in our cities, a loss of good blood that must be stayed or we are undone as surely as the Greeks and Romans. The ancient prophecies of the destruction of Babylon, Ninevah and Tyre apply equally well to London and Paris and New York, and to all other places where men try to live away from the land. Man is a land animal, as the preacher of urban socialism has said, but he is also an air animal and a daylight animal, and an animal that needs to be raised in a separate family group, instead of in an urban incubator.

That one people after another, one civilization after another has culminated and decayed need be ascribed to no mysterious decrees of fate or jealousy of gods fearful of being displaced by a more perfected human race. The reason is obvious and thoroughly well known, if not adequately recognized. Each people in turn became urbanized, lost its connection with the soil and departed out of its natural environment, so that its members no longer generally attained their full development of physical strength, mental energy and social efficiency. Eugenics represents an effort on

our part to resist these tendencies to urban deterioration, to interpose another set of standards of what normal life should be.

Statistically speaking cities are centers of population, but biologically or eugenically speaking, cities are centers of depopulation. They are like sink-holes or *siguanas*, as the Indians of Guatemala call the places where the streams of their country drop into subterranean channels and disappear. It never happens that cities develop large populations that go out and occupy the surrounding country. The movement of population is always toward the city. The currents of humanity pass into the urban siguanas and are gone. Thoroughly urbanized people cannot go back and live in the country. They have no resources of mind, no adequate initiative for meeting agricultural responsibilities, no interest in the world or in themselves that enables them to support an existence apart from the crowd. They are as helpless and ill-at-ease as a honey-bee caged away from the hive, or a sheep away from the flock. Not all of the people who live in cities and towns are urbanized in this sense. Many appreciate the country all the more keenly because they are shut away from it for a part of the time. On the other hand, many have a merely sentimental interest in farm life or in the out-door world without recognizing the importance of these factors in human development.

THE EDUCATIONAL ASPECT

Agriculture is not only the basis of our civilization in the mere economic sense of affording food to support our physical existence, but in a still more fundamental, biological sense. It is only in an agricultural state that the human individual attains a normal acquaintance with his environment and a full endowment of intellectual and social faculties of this race. Wandering savages and shepherds may be strong and cunning as individuals, but in other ways they are lacking, and this is true of people raised in cities. Rich and poor alike are defective, deprived of normal existence, lacking in normal development, and unable to maintain themselves continuously, from one generation to another. It is for this reason that cities have to be recruited continually from the country. The biological fact is that the human species does not thrive in towns. The second generation is generally inferior and the third generation usually fails. A few by reason of strength of character and of family ties are able to survive longer, but even the Jews, who excel other races in these respects and withstand urban conditions better, are not a prolific or a numerous people. They have continued to exist as urbanites, but have not prospered or replenished the earth. Perhaps the promise to the seed of Abraham awaits a return to an agricultural state.

From an enlightened eugenic standpoint every child should be born and raised on a farm, in contact with the actual world of kindred, neighbors and friends, the domesticated plants and animals that represent the basis of our existence, and the wild things that live without our assistance or even in spite of our efforts to destroy them. To grow up under these conditions of family, farm and out-of-doors is necessary for normal development, in order to allow the normal human characteristics to come into expression.

A RETURN TO BARBARISM

It is obviously unreasonable to expect that children who are deprived of intimate contacts with nature or with the older generation can attain a complete development of their natural powers. The effect of the urban conditions and of the system of elaborately graded schools is to take the children out of the family group and limit their contacts largely to other children of the same age —contacts that do not make for any full development of the child in the direction of general intelligence and responsibility. The bonds of the family and other social ties are loosened and there is a real return to conditions like primitive barbarism, among our urban populations.[1]

The transmission of desirable char-

[1] Cook, O. F. Definitions of Two Primitive Social States, *Journal of Washington Academy of Sciences*, Vol. II, p. 125, 1912.

acters from the parents is not enough. In addition to the prenatal inheritance there must be a postnatal acquisition of civilizing habits and accumulated experience of the race, or children with the best blood may grow up ignorant and irresponsible, as many do. Eugenics is conceived very often in too narrow a sense, as relating merely to the transmission of desirable characters, as though this alone would solve the problems of our civilization. There needs to be a sister-science of *euphanics*, to treat of the *expression* of desirable characters, the biological factors underlying the problems of education. Eugenics without euphanics can get nowhere. The best seed is wasted unless the plants can grow to normal maturity. Breeding a crop to its highest possibilities is of little avail unless there are to be farmers who know how to give the cultural treatment that will allow the characters of superior varieties to come regularly into expression. Practical eugenics must look forward not only to the provision of normal parents and normal children, but to parents who shall be able to care for the normal development of their children.

CHILDREN NEED FARM CONDITIONS

Not to be raised on a farm is a cruel privation, a denial of the normal childhood of our race that no previous eugenic precautions or subsequent educational manipulations can make good. Many excellent and very intelligent people do not know that children need farm conditions, but it is true nevertheless, and needs to be recognized before we shall have any just or practical appreciation of eugenic or educational values. Many of our educators know how hopeless the urban children are, under the urban conditions, but they are engaged to handle such children and are doing the best they can. The urban problems are pressing and cities pay high salaries to get capable men. The result is that not only our educational institutions, but our educational ideas as well, are being cast almost exclusively in the urban mold, with no recognition of the educational value of rural life. Every year thousands of misguided parents, all over the United States, are moving to towns in order that their children may have the "advantages" of the large graded schools, the over-crowded education-factories where the city children are put through the elaborate machinery that is necessary to handle helpless humanity in large masses. The school is no substitute for the home, much less the city school for the farm home.

In cities the little children have to be sent to the school, the kindergarten, or the day-nursery, to keep them out of danger while the parents are at work or at play, but in the country where the children can be out-of-doors they do not need to be caged. The projection of urban ideas and methods of education into the country makes needless difficulties. The little children not only do not need to be sent to school, but are much better off, educationally and otherwise, if allowed to stay at home. There is no good reason why normal children of normal, intelligent parents living in the country should be sent to school before the eighth or ninth year. Nor is there any reason why any favorably situated country child should go to school for more than six months in the year. Country schools need to be improved in many ways, but running them longer is not an improvement.

It is true, of course, that many children, and especially urban children, are better off at school than at home, but that some children lack favorable home conditions does not make it reasonable to keep others from such an advantage. It would not be argued that all children should be taken away from their parents because some children are orphans, or because some parents are incompetent, careless or cruel. Yet there can be no doubt that this is very frequently the effect of our system, to make children practically orphans by turning them over wholly to the school.

PARENTS SHIFT RESPONSIBILITY

The ten-months school of the town is a concession to the convenience of parents and serves no truly educational purpose. Teachers and pupils would both be advantaged if formal tuition were limited to six months, instead of

allowing the school to develop into a separate institution apart from the life of the community. But now that the schools have assumed responsibility for the children, the parents do not want to take them back. Summer schools and all-year schools are now coming into vogue. Why should people be bothered with children for two or three months in the summer when somebody can be hired to take care of them?

Obviously this whole urban attitude toward children is not eugenic, but dysgenic. The truth is that urbanized people do not want to have children, and do not want to take care of them after they are born. They may be willing to feed or clothe them, but to look after them and have them about is too much of a responsibility, involves too much wear and tear on the overwrought parental nerves. This does not mean that urban parents are more wicked or unnatural than country parents, but only that the urban conditions are unfavorable for raising children, a fact that is generally admitted, though seldom taken into account as a basis of action.

CITY POPULATIONS SUPERIOR

Instead of being composed of naturally inferior stocks, city populations are probably superior to the residual population of the rural districts. The general tendency in each generation is for the best of the rural population, the most energetic and capable, to be drawn to the city. If city populations average better in some respects, as statisticians have claimed, this does not prove that the city is a better place to live, but only shows the more definitely that the drain of the city is a menace to the race in sterilizing and destroying the superior elements of the population. The aggregate losses are probably much more serious than those caused by war, because more general and continuous.

If the time has really come for the consideration of practical eugenic measures, here is a place to begin, a subject worthy of the most careful study—how to rearrange our social and economic system so that more of the superior members of our race will stay on the land and raise families, instead of moving to the city and remaining unmarried or childless, or allowing their children to grow up in unfavorable urban environments that mean deterioration and extinction.

Until recently cities have been distinctly in advance of any of the rural districts, not only in holding out greater inducements in the way of income, but in many other ways. Not only schools for the children, but many other conveniences, luxuries, pastimes, and amusements are supplied in cities much more easily and abundantly than in the country. But it must not be taken for granted that all of these things are as desirable or as necessary as they seem to be to people who have become accustomed to city life. Comfort should not be confused with civilization, as Disraeli pointed out. Living easily is not necessarily living well, or in a way that will give the most satisfaction to the individual or contribute most to the progress of the race. Most of the people who really want to live want to live in the country. Those who are intent upon some special pursuit of wealth or pleasure or freedom from responsibility must hold to the city as the only place to follow the courses they have chosen. But these professional urbanites are attempting to grasp a small part of life without feeling the need or accepting the resposibility of a complete existence. Certainly they do not represent the permanent nucleus or germ plasm of the race, the seed of the future that should demand the primary consideration of the eugenist.

EUGENISTS MUST GIVE HEED

That the general public, and even the scientific public does not recognize this intimate and essential relation of eugenics to agricultural habits of life, makes it all the more necessary that professed eugenists should recognize it, and should develop a constructive interest in the solution of the problems of agricultural existence.

No doubt it is possible to have a much greater share of the comforts, conveniences, social contacts, and educational opportunities that are associated in our minds with the life of the town, but it

is a mistake to suppose that rural life is to be improved only in the direction of making it more like the life of the city. To carry this tendency too far would be to lose advantages of the country and bring people all the faster to the city.

Many of the supposed limitations of the country are only fancied, and are commonly accepted as necessary only because the urban tendencies of our civilization have been so strong as to call most of the more intelligent and progressive people away to the cities. The general rule is that as soon as people get to the place where they might become constructively interested in the life and progress of the rual community they move to the city. To cure this folly a broader understanding is needed, a biological interest in life, not merely a financial or social interest. The most practical eugenists of our age are the men who are solving the problems of living in the country and thus keeping more and better people under rural conditions where their families will survive. We must learn how to establish ourselves and our families in our true places, as members of our race, nation and community, instead of allowing some shallow motive of gain or pleasure to lure us to the destruction of a sterile existence. Most of the people who are destroying themselves in cities have little more reason for it than the insects that dash themselves into the electric lights.

MUST REVERSE MIGRATION

The cities represent an eliminating agency of enormous efficiency, a present condition that sterilizes and exterminates individuals and lines of descent rapidly enough for all but the most sanguinary reformer. All that is needed for a practical solution of the eugenic problem is to reverse the present tendency for the better families to be drawn to the city and facilitate the drafting of the others for urban duty. It is not necessary that anybody be sterilized or otherwise coerced, compelled or bribed by eugenic regulations. The sanitary precautions now prescribed by some of our states may be sufficient for their purposes, which are hygienic, but not eugenic. To protect against disease and deformity is a work of mercy, and of economy for the tax-payer, but not necessarily a measure of progress for the race, if the effect is to preserve undesirable lines of descent that the natural agencies would eliminate.

Anybody who chooses to live in the city should be allowed to do so. But everybody should make the choice for himself and not be deprived of agricultural contacts or access to the land. Raising children in cities is taking a responsibility that nobody is warranted in assuming. It infringes the birthright of a normal existence and ought to be reckoned in the same general class of crimes as child-labor in factories or the starving or maiming of children by professional beggars to make them objects of pity, or the other kinds of conscious and unconscious cruelty that keep the child from a normal development.

To reach such a basis of freedom of choice of a normal existence would require many changes of our social and economic structure, and this is a part of the problem of constructive eugenics, with an enlightened interest in human welfare, to find the course by which changes may be made, so as really to improve the conditions of existence and not merely to ameliorate and make a little more tolerable the evil courses which our civilization has taken.

Socialism, the single tax and many other schemes of economic reform have been proposed in the last century, but mostly from a narrowly urban point of view. They represent efforts to improve urban conditions by a more equable distribution of wealth. The sense of justice is violated when some riot in palaces and others fester in slums. Urban reformers urge a readjustment, so that all may live in equal comfort in second-class hotels. And in order to do this they would not hesitate to destroy the very basis of rural civilization. They do not understand that the farm represents a kind of life essential to the well-being of the race, but look upon agriculture merely as one of the arts, a means of production of food commodities for the support of city populations.

Economic reforms are needed, no doubt, but it is much more important

that they be studied from the standpoint of rural than of urban interests, if the welfare of the race is to be served. Economic changes alone cannot be expected to solve the problem of urban degeneration, which has no very definite relation to the economic status of the people. From a biological or eugenic standpoint the palaces are as bad as the slums, and the middle-class neighborhoods are little better. Indeed, in some respects the middle-class children seem to have the worst of it. They do not get the wit-sharpening contacts of the newsboys and messengers, nor the opportunities of outdoor life and travel that enable some of the wealthy families to keep healthy and run along for several generations, especially when they have country places and rural conditions and contacts for several months in the year. Such familes are admittedly the cream of the city populations—the exceptions to the rule of deterioration that is generally recognized.

One important advantage that our age has over all the others is a better understanding of the fact that progress must be consecutive and evolutionary, that little or nothing is to be expected from revolts and revolutions that would destroy or change too suddenly any important or well established relation of life. No matter how good the motive or how pure the justice of any revolutionary effort, it can be no aid to true progress unless it articulates in a constructive way with actual conditions and factors that determine the course of development. With the problems clearly apprehended, the folly of revolutionary measures is apparent. It is as important to study the means of bringing the right changes to pass as to determine what the changes should be.

To recognize the relation of eugenics to agriculture does not solve the problems of our race, but it indicates the basis on which the problems need to be solved, and the danger of wasting too much time and effort in attempting to salvage the derelict populations of the cities. However important the problems of urban society may be, they do not have fundamental significance from the standpoint of eugenics, because urban populations are essentially transient. The city performs the function of elimination, while agriculture represents the constructive eugenic condition which must be maintained and improved if the development of the race is to continue.

The Non-Inheritance of Acquired Characters

It is reported that the war has put a stop to a breeding experiment with guinea-pigs, conducted in Austria by A. Wrzosek and A. Maciesza since 1907. The experiment of Dr. Brown-Sequard with these animals, a generation ago, long formed one of the pieces of evidence most relied upon by those who believe acquired characters can be transmitted through the germ-plasm. The experimenter injured the nervous system of his animals in various ways, and reported that their offspring showed similar defects. It was soon pointed out that there were other explanations of the result, which did not at all involve the inheritance of acquired characters, and most geneticists long ago ceased to attach any weight to the Brown-Sequard experiments in that connection. As they continue to be much quoted by popular writers, however, the Austrian biologists undertook to repeat the experiment and see if they could produce the same result. They failed utterly to find any evidence that acquired characters can be handed on as Brown-Sequard thought.

TESTING CRIMINAL OFFENDERS

Scientific System of Police Administration Requires That Heredity and Mentality of Persons Arrested Should Be Ascertained Before They Are Brought to Trial—New York Police Department Installs Laboratory for This Purpose—Examples of Its Work

THERE are still plenty of people to be found who think that, given a proper chance, every child will turn out well. If the child grows up to become a pick-pocket, or sets fire to an orphan asylum, it is assumed that society has sinned against him, at some time or other, by depriving him of the proper environment. If society does not actually create all the criminals, as we are sometimes asked to believe, we are at least expected to accept the idea that criminals are men and women who have deliberately or unknowingly broken some man-made law, and who, if given a stiff enough jolt in the way of a fine or imprisonment, will be brought to their senses and led to see that it pays better to walk within the limits of the statutes therein made and provided.

Such a view, more or less modified, still influences a large part of law-making, and the execution of laws. That view is based principally on metaphysical doctrines and theories of "natural rights" and the equality of man.

The way of modern science is to test these time-hallowed theories by exact observation, by classifying and measuring the facts. Criminology has undergone a good deal of this process, and the first results were a wide swing of the pendulum in the other direction. Lombroso and others put forward the idea of the "born criminal," the man who was predestined to become a murderer, or a forger, or whatever the signs might indicate. This extreme view is now largely discredited, but students of the subject nevertheless generally recognize nowadays that many persons are born with some inherent defect, which makes it impossible for them to be law-abiding citizens.

Students recognize this fact, we have said; but, extraordinary as it may seem, almost no effort has been made to take advantage of this fact in the United States in the administration of police power. There is only one police department in the United States which maintains a laboratory for the examination of adult offenders, and that is New York where, since January, a well-equipped psychopathic department has been in operation.

A PRELIMINARY SURVEY

Five or six hundred people are arrested each day, on the average, in New York City. The question of how many of these are mentally defective and irresponsible was of special interest to Police Commissioner Arthur Woods, and it was arranged that Prof. Louis E. Bisch, of Columbia University, conduct an investigation which would yield an answer to this question.

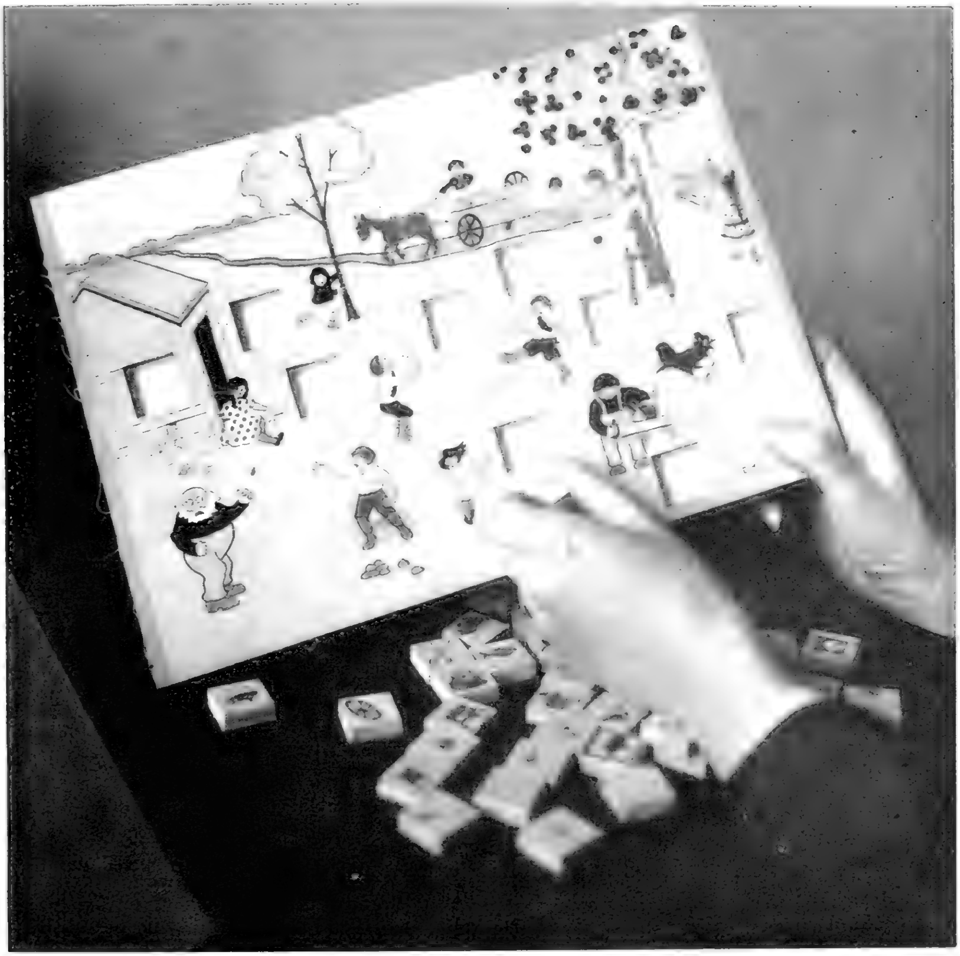
A couple of months' preliminary survey put Dr. Bisch in a position to report that, on a very conservative estimate, at least 5% of the number deserved a careful mental examination. This meant that twenty-five or thirty a day were perhaps in need of hospital rather than prison custody. Accordingly, the commissioner asked Dr. Bisch to take charge of a psychopathic department which would report on such cases.

The department headed by Dr. Bisch includes also a psychologist (Dr. E. C. Rowe) to give psychological tests; two eugenicists (William F. Blades and Dr. Harry W. Crane) to make investigations at the homes and to trace the family history; and a clerical force.

Every morning, in the New York Police Department, there is held the famous "line-up," when all the prisoners

A TEST FOR MUSCULAR CONTROL

This is one of the simplest tests applied to people who are examined in the Psychopathic Laboratory, and serves to show whether the subject can coördinate his muscular actions: whether the limbs obey the brain. It serves to show the existence of certain gross forms of organic defect. (Fig. 1.)



THE HEALEY PICTURE PUZZLE

This ingenious device has proved to be a great aid in measuring the mentality of the feeble-minded. The person examined must put in the board squares which will make the people pictured do suitable things, and this gives the examiner a chance to see whether he is able to observe and reason intelligently. Two boys in the middle of the picture, for instance, are evidently kicking a football, and the square bearing the picture of a football should be put in the opening. If the person tested puts in a picture of a cart wheel, or a pair of shears, it shows a lack of sense. Of course, the interpretation of the evidence furnished by such tests as this depends on the previous experience of the examiner, and upon a large body of normal and abnormal persons having been tested, so that the examiner knows about what a person of a certain grade of mentality should do. (Fig. 2.)

taken on the previous day, who are accused of serious offenses or who have a previous police record, are interviewed in the big gymnasium.

Judging by their appearance or their conversation, their records, or the circumstances connected with their misdeeds, Dr. Bisch selects the prisoners who he thinks are likely to be mentally deficient. They are then taken to his laboratory for examination. If they are found to be normal, they are turned back to the police officers with a statement to that effect, and prosecution follows. If they are found to be abnormal, a detailed report and diagnosis are submitted. On the basis of this, recommendations are made for

the proper segregation or treatment. The diagnoses which have been made at the laboratory include the following: Feeblemindedness, psychoses, psychic constitutional inferiority, drug addictions, sex perversions and inversions, etc.

SOURCES OF PATIENTS

Not all the cases investigated come from the "line-up," however. The lieutenants in charge of some of the police precinct stations send patients to the psychopathic department directly, if it appears advisable. The city magistrates frequently ask to have reports on some of the prisoners tried before them, before pronouncing sentence. The parole board refers many parole applicants to Dr. Bisch for examination. The courts of general as well as special sessions have taken a proper interest in this work and are sending certain prisoners to the psychopathic laboratory to be examined before sentence is passed. Another common source of subjects is a large number of people who call at headquarters insisting upon seeing the officials to ask their aid in various matters. Among these people frequently appears a so-called "crank" or person suffering from some form of mental trouble.

Often they are cases which might ordinarily escape detection for a long while. Quite recently, for example, a woman called to ask the police commissioner's aid in getting her son-in-law to support her daughter properly. Such a request seemed unexceptionable, but something in her manner aroused suspicion, and she was induced to call upon Dr. Bisch. His conversation with her indicated that she was not wholly sane, and an investigator was sent to look up her family. She was found to be living with three relatives, all unbalanced mentally, and with a child who was exposed to such a bad environment that his own mind was becoming disturbed.

A more common type of case in which the psychopathic laboratory proves its usefulness is the following: A man who wrote to a large manufacturing concern, threatening to blow up their plant unless a sum of money was paid him, was arrested and charged with attempted blackmail. Examination showed him to be insane; he really thought the firm owed him money for services rendered. He was sent to a hospital for the insane instead of to a prison.

Another case is that of a man 36 years old, found on the roof of a building and charged with attempted burglary. Anywhere else, the case would probably have attracted little attention; the man would have been convicted on a felony charge and sent to the penitentiary for at least a year, in a routine way, by a court too heavily loaded with work to give the case any individual attention. In this instance, the man was sent to Dr. Bisch, who found that he had received, years before, a blow on the head which had affected him mentally. To send him to prison would have been utterly useless; he was not responsible for his actions. Nevertheless, he talked intelligently on most subjects, had a good memory for incidents which happened before his accident, and would have been passed as normal by anyone except a trained scientific observer.

AN INTERESTING CASE

One of the most interesting cases which the laboratory has handled is that of F. B., a young man of excellent parentage, who had been brought up in a very good environment with every care and advantage which intelligence and a comfortable income could provide. He was arrested for turning in a false alarm of fire, and it was found that he had also set ten or a dozen fires which had destroyed buildings in the neighborhood. In many respects he gave the appearance of being normal mentally, but Dr. Bisch's examination showed that he was suffering from an insanity. His parents were people of good standing and superior intelligence, but the family history investigation disclosed the fact that certain other ancestors had been of a somewhat similar neurotic constitution, though their condition is not believed to have brought them before the law. Obviously this boy did not belong in prison. He was sent to a hospital for mental and nervous diseases.

F

With your pencil make a dot over any one of these letters **F G H I J,** and a comma after the longest of these three words: **boy mother girl** Then, if Christmas comes in March, make a cross right here........ but if not, pass along to the next question, and tell where the sun rises .... If you believe that Edison discovered America, cross out what you just wrote, but if it was some one else, put in a number to complete this sentence: "A horse has..........feet." Write *yes*, no matter whether China is in Africa or not.........., and then give a wrong answer to this question: "How many days are there in the week?" .... Write any letter except *g* just after this comma, and then write *no* if 2 times 5 are 10... .... Now if Tuesday comes after Monday, make two crosses here...........; but if not, make a circle here ....or else a square here.......... Be sure to make three crosses between these two names of boys: George.. ....Henry. Notice these two numbers: **3, 5.** If iron is heavier than water, write the larger number here.........., but if iron is lighter write the smaller number here.......... Show by a cross when the nights are longer: in summer?...... in winter?...... Give the correct answer to this question: "Does water run uphill?"............. and repeat your answer here .... Do nothing here (5 + 7=..........), unless you skipped the preceding question; but write the first letter of your first name and the last letter of your last name at the end of this line:

MANY CHANCES FOR THE INTELLECT TO TRIP

Any one who can follow all the directions on the above form, accurately and without delay, is certainly not very low in the scale of intelligence. The normal boy can do it with reasonable accuracy, but the feebleminded boy is usually hopelessly confused. (Fig. 3.)

For measuring the mentality of the people who come to it, the psychopathic department uses thirty or more tests, picking out in each instance the ones which seem best adapted to the case. In addition to the earlier forms of the Binet test constant use is made of the Stanford revision, which possibly is more suitable for use with adults. The other tests are, for the most part, well known to those whose business it is to handle such instruments. Simple questions are asked, and the subject's reasoning power and other abilities tested, not only by his answer, but by the time it takes him to evolve it. Such questions have been asked as:

"What difference would it make to people if the price of coal went up to twice what it is now?"

"Why do people send their children to school instead of making them work?"

"Which would be worst: to have all the money in the world disappear or to have all the steel in the world disappear? Why?"

One of the tests used is the Trabue Language Scale D, which is given

below. The subject is asked to write *one* appropriate word in each blank, and is given seven minutes for the task:

4. We are going__________school.
76. I__________to school each day.
11. The__________plays__________her dolls all day.
21. The rude child does not__________many friends.
63. Hard__________makes__________tired.
27. It is good to hear__________voice__________friend.
71. The happiest and__________contented man is the one__________lives a busy and useful__________.
42. The best advice__________usually__________obtained__________one's parents.
51. __________things are__________satisfying to any ordinary__________than congenial friends.
84. __________a rule one__________association__________friends.

It does not follow that a person is abnormal, simply because he fails on this or any other single test. It is highly essential that all tests be *interpreted*, and, naturally, such evaluation should be made only by persons having a wide experience in these matters.

The "Opposites" test is one which is being widely recognized as very useful. The patient is given a list of words such as

good	outside	quick
tall	big	loud
white	light	happy
false	like	rich
sick	glad	thin
empty	war	friend

He must write down as rapidly as possible the words which mean the exact opposite of each of these. A normal person can write them almost as rapidly as his hand can move the pencil; but a feebleminded individual, even though he has spent a number of years in school, becomes bewildered at such a task.

In examining the higher levels of intelligence the manner in which the individual reacts to complicated directions is frequently suggestive. An example of such a set of instructions is given in Fig. 3.

The useful "form boards," described by Dr. Howard A. Knox in the JOURNAL OF HEREDITY for March, 1914, together with those of Healy, etc., are much employed; they require the person examined to fit blocks into their proper places in a frame. Some people insist on putting round pegs into square holes, and that in itself is significant.

The Healy pictorial completion test shown in Fig. 2 is a test for apperceptive ability. Writing with the aid of a mirror, as illustrated in Fig. 4, gives an idea of the subject's ability to learn, and of his motor-control. Memory, concentration, and other easily tested abilities are also observed, and the examiners are finally able to give an accurate judgment of whether the subject is mentally capable of holding his own in competition in the world, or whether he is so constituted that he requires special care.

INVESTIGATION OF HEREDITY

The family history is one of the most interesting and essential features of the study which this laboratory makes of its patients. The special investigators, who have made a careful study of this part of the work, visit the home of the patient, the schools he attended, his favorite resorts, etc., and not only gather data concerning his behavior, habits, peculiarities, etc., but also make special inquiries concerning the mental and physical peculiarities of the patient's brothers and sisters, parents, grandparents, aunts, uncles, etc. The report of these investigators is usually of assistance and sometimes a decisive factor in making a diagnosis of the patient's condition. It is already apparent that heredity is an important element to be considered in a study of cases of the criminal type.

"Crime," says Dr. Bisch, "should never be considered apart from mentality. Hitherto the police department has presented facts regarding evidence of guilt when the prisoner was brought before the presiding judge. Now, in addition, the department also furnishes certain facts regarding the mental responsibility of the offender. This step is a logical one and is another proof of the practical value which psychology possesses. If a man is feebleminded at his fifth conviction, he was just as feebleminded at his first

WRITING WITH A MIRROR IS HARDER THAN IT LOOKS

The boy examined is given a card with a pattern traced on it, and is asked to follow this pattern with his pencil, guiding himself solely by the reflection of the pattern in a mirror. A shield just above his hand prevents him from seeing the movements of his pencil, except by the aid of the mirror. Almost anyone finds this difficult at the first trial, but after half a dozen attempts the normal person can follow the diagram correctly, while the feeble-minded person is almost as much puzzled on the tenth trial as on the first. The test therefore aids in showing how much capacity a person has for learning, and how quickly the mind adjusts itself to a new problem, (Fig. 4.)

conviction; it will pay the community, therefore, to examine, segregate and properly treat prisoners before arraigning them, instead of waiting until they reach the court or penitentiary. The psychopathic laboratory is a huge sieve, its aim being the selective classification and disposition of the criminal population. It is not a sentimental undertaking—it is scientific, wise and humane."

The reader will probably agree with this verdict. Why, then, one naturally asks, is the criminal offender not handled in this manner everywhere?

Largely, it must be supposed, because of the lack of public knowledge sufficient to educate public sentiment. Chicago has two psychopathic laboratories for juvenile offenders, and here and there sporadic work is being done; but New York is absolutely the only place in the United States where adult offenders are examined systematically in the light of their mentality and their family history before being brought to trial.

Although only a short time in existence the psychopathic laboratory has already demonstrated beyond question that what is urgently needed is an institution for feebleminded criminals. These individuals never will be normal and it is folly to sentence, release, rearrest, and sentence them all over again as is the procedure nowadays. The criminal insane and the feeble-minded of ordinary types are fairly well cared for in some States, but the feeble-minded of criminal tendencies are a special class and should receive special segregation and training suited to the grade of mentality they possess.

German Suggestions for Constructive Eugenics

Germany continues to take an active interest in proposals for making good the eugenic loss caused by the war. An article by Dr. von Behr-Pinnow in the *Archiv für Rassen- und Gesellschafts-Biologie* (XI, 3) is thus summarized in the last issue of the *Eugenics Review:*

There are two means of increasing the population. One is by combating the causes which lead to a fall in the birth rate; the other is by keeping the death rate low. The people, beginning with school children, must be enlightened with regard to the importance of large families. The housing laws ought to be modified, hygienic homes secured for all, and every attempt by houseowners to discriminate in favor of childless couples as employes or tenants checked. Recognition ought to be given to large families by the government and expressed in a scale of wages (including supplementary payments) for all persons employed by the state, proportioned to the size of their families. The same thing should be enforced if possible (there are legal obstacles in the way) in the case of persons privately employed. Children must be discouraged from leaving their parents' home before they are of age and spending their wages on themselves alone, instead of giving a share (20%, the author suggests) to their parents; for this leads only to a decrease in the size of families. Working people can frequently be heard to say nowadays that it does not pay to have children, for in old age one gets nothing from them. The imperial insurance laws should likewise be altered in favor of married people and large families; and engaged and newly married couples must be protected (by the withholding of their names and addresses) from the flood of advertisements of contraceptives and the like which is now poured out on them. There ought also to be more stringent penalties for such advertisements, and physicians alone should be permitted to give public instruction in regard to the limitation of offspring. Infantile mortality can be decreased by providing free nurses, midwives and medical attendance to all insured women, by the payment of full insurance money for sickness during the last six weeks of pregnancy, and by granting premiums equal to one-half the sick pay for twelve weeks after confinement in winter or twenty-four weeks in summer, to all insured mothers who nurse their own children. New provisions in regard to the insurance of motherhood are also wanted, and better facilities, provided by the local government boards, for the care of infants and small children. Private societies formed for the same end and for the care of orphans must also be encouraged and assisted by the state. Funds can be raised in part by an extra tax on the unmarried and childless couples, in part by confiscation by the Government of the estates of people who die intestate and have no heirs within the third degree of succession.

"BULL-DOG" CATTLE

Niata Breed, Described by Darwin, Becoming Exceedingly Scarce—Presumed Mutation Accounts for Extraordinary Jaw and Face—Inheritance of Peculiarities Is Blended

THE peculiar jaw characteristic of a bull-dog is a mutation which is not confined to the dog alone, but appears from time to time in other animals. It has been reported in foxes, and Charles Darwin found a whole race of cattle in South America which showed this peculiarity. Writing of his trip through the province (now the department) of la Colonia in Uruguay, he said:[1]

"On two occasions I met with in this province some oxen of a very curious breed called ñata or niata. They appear externally to hold nearly the same relation to other cattle which bull or pug dogs do to other dogs. Their forehead is very short and broad, with the nasal end turned up, and the upper lip much drawn back; their lower jaws project beyond the upper, and have a corresponding upward curve; hence their teeth are always exposed. Their nostrils are seated very high up and are very open; their eyes project outwards. When walking they carry their heads low, on a short neck; and their hinder legs are rather longer compared with the front legs than is usual. Their bare teeth, their short heads, and their upturned nostrils give them the most ludicrous self-confident air of defiance imaginable.

"Since my return, I have procured a skeleton head through the kindness of my friend Capt. Sullivan, R. N., which is now desposited in the College of Surgeons. Don F. Muniz, of Luxan, has kindly collected for me all the information he can respecting this breed. From his account it seems that about eighty or ninety years ago they were rare and kept as curiosities at Buenos Aires. The breed is universally believed to have originated among the Indians southward of the Plata, and that it was with them the commonest kind. Even to this day, those reared in the provinces near the Plata show their less civilized origin, in being fiercer than common cattle, and in the cow easily deserting her first calf, if visited too often or molested. It is a singular fact that an almost similar structure to the abnormal one of the niata breed, characterizes, as I am informed by Dr. Falconer, that great extinct ruminant of India, the Sivatherium. The breed is very *true;* and a niata bull and cow invariably produce niata calves. A niata bull with a common cow, or the reverse cross, produces offspring having an intermediate character, but with the niata characters strongly displayed; according to Señor Muniz, there is the clearest evidence, contrary to the common belief of agriculturists in analogous cases, that the niata cow when crossed with a common bull transmits her peculiarities more strongly than the niata bull when crossed with a common cow. When the pasture is tolerably long, the niata cattle feed with the tongue and palate as well as common cattle, but during the great droughts, when so many animals perish, the niata breed is under a great disadvantage, and would be exterminated if not attended to; for the common cattle, like horses, are able just to keep alive by browsing with their lips on twigs of trees and reeds; this the niatas cannot so well do, as their lips do not join, and hence they are found to perish before the common cattle. This strikes me as a good illustration of how little we are able to judge from the ordinary habits of life, on what circumstances, occurring only at long intervals, the

[1] Darwin, Charles, "Voyage of the Beagle," p. 158 ff. New York, 1909.

SUPPOSED REPRESENTATIVE OF THE BULL-DOG CATTLE

This cow is believed to be a hybrid, although judging from descriptions it cannot be a full-blood, ñata, the race in Uruguay which was first brought to the attention of science by Charles Darwin. It is characterized, among other peculiarities, by a short neck and upper lip, to such an extent that in many specimens the two lips do not meet. Apparently it arose as a mutation. (Fig. 5.)

rarity or extinction of a species may be determined."

Knowledge of the ñata breed[7] has been little increased since Darwin's time and, so far as the writer is aware, no photographs of it have been published. The JOURNAL OF HEREDITY therefore undertook, nearly three years ago, to find what had become of this curious bovine race, and to secure illustrations of it. A fruitless correspondence was conducted with numerous South Americans, but finally a member of this association, B. Lorenzo Hill, of Montevideo, interested himself in the case, and for the past year has prosecuted a diligent search for information about the breed. The principal newspapers of Uruguay cooperated by printing the American Genetic Association's appeal, at the instance of Mr. Hill, and another member of the association, Don Hugo A. Surraco Cantera, Inspector Nacional de Ganadería y Agricultura, exerted himself actively in the quest. He was finally able to secure the accompanying photographs from a rancher in the district of Chubut. They were at once published in several of the most widely circulated newspapers of Montevideo, accompanied by another appeal from the Uruguayan Department of Agriculture, in which ranchers were asked to assist the American Genetic Association in getting more detailed information. But in view of the evident rarity of ñata cattle at the present day, it seems advisable to publish these photographs in the JOURNAL OF HEREDITY without further delay.

A comparison of the accompanying photographs, with Darwin's description, makes it seem probable that the animals pictured are not full-blood ñatas, but a

REMNANT OF A NEARLY EXTINCT BREED

Because of their unusual jaws, Darwin says, the ñata cattle could not pasture successfully when food was scarce, and therefore were crowded out by other types. The breed is supposed to have arisen among the Indians, but the production of high-grade Herefords and other improved breeds in Uruguay nowadays makes such an animal as the ñata no longer profitable, and it appears to have become almost extinct. (Fig. 6.)

first cross between the ñata and a common cow, for the peculiarities of the head are certainly much less than Darwin's description would lead one to expect.

The difficulty which has been encountered in finding any trace of these cattle at the present time indicates that the race has become practically extinct. Judging from the appearance of the cows, it could never have been very valuable, and the introduction of the best European breeds, particularly the Hereford, into Uruguay in recent years has raised the standard of live stock so much that, presumably, it is no longer profitable to keep ñata cattle. Add to this the possibility that the physical peculiarities of the breed have contributed to their disappearance, as Darwin describes, and it will readily be understood that their numbers might diminish greatly in the course of half a century.

Live-stock breeding has now reached such a high point in Uruguay that it is not probable that any one hereafter will care to breed such cattle as these for commercial purposes. In order to prevent the entire disappearance of an interesting variation, it would be worth while for some zoological garden to secure specimens of the ñata. Full-blood specimens, if they can be secured, would be of much value to geneticists, and ought to be fully as interesting to the public as the common stock-in-trade which every zoological garden in the world keeps on hand, with pathetic fidelity to traditions, and which every frequenter of such institutions has seen at frequent intervals throughout his life.

WHAT IS HAPPENING TO THE HAWTHORNS?

Half a Century Ago Only Ten Species Were Recognized in North America, Now There Are More Than 700—Several Lines of Evidence Indicate That Many of the New Forms Are Not New Species but Natural Hybrids

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THOSE interested in the origin of species cannot afford to overlook Crataegus, the hawthorn genus, on account of the extraordinary multiplication of species in that genus during the last fifty years. Gray's Manual of Botany in 1867 records ten species and four varieties; in 1869 his classification is the same, while Focke in Engler and Prantl's "Die natürlichen Pflanzenfamilien" gives only thirty or forty species for the whole North Temperate zone. Since 1900, however, the increase in the number of species of the genus has been enormously rapid. In 1901 Britton's Manual for the northern states west to the hundredth meridian records thirty-one species; in 1903 Small's Flora of the southeastern United States of America gives 185; in 1905 Sargent's Trees of North America, 132; while Gray's New Manual, published in 1908, describes sixty-five species and fifty varieties. In 1910 those who had discovered the new forms were N. L. Britton, eight species and two varieties; W. W. Eggleston, ten species and three varieties; C. D. Beadle, 144 species; W. W. Ashe, 165 species, and C. S. Sargent, 524 species and six varieties.

This unusual state of affairs was noticed by H. K. Brown (1).[1] In 1910 in the Bulletin of the Torrey Botanical Club (page 152), he published an account of his investigation of the subject in an article entitled "The Genus Crataegus and Some Theories of the Origin of Species." He had written to the leading authorities: C. S. Sargent of the Arnold Arboretum; C. D. Beadle, Director of the Biltmore Herbarium; W. W. Eggleston of the New York Botanical Gardens; Ezra Brainerd of Middlebury College, Middlebury, Vt., and Mr. Dunbar of the Park Department, Rochester, N. Y., and asked them a series of questions hoping to get their opinion as to the cause of the extraordinary multiplication of species in the last fifty years.

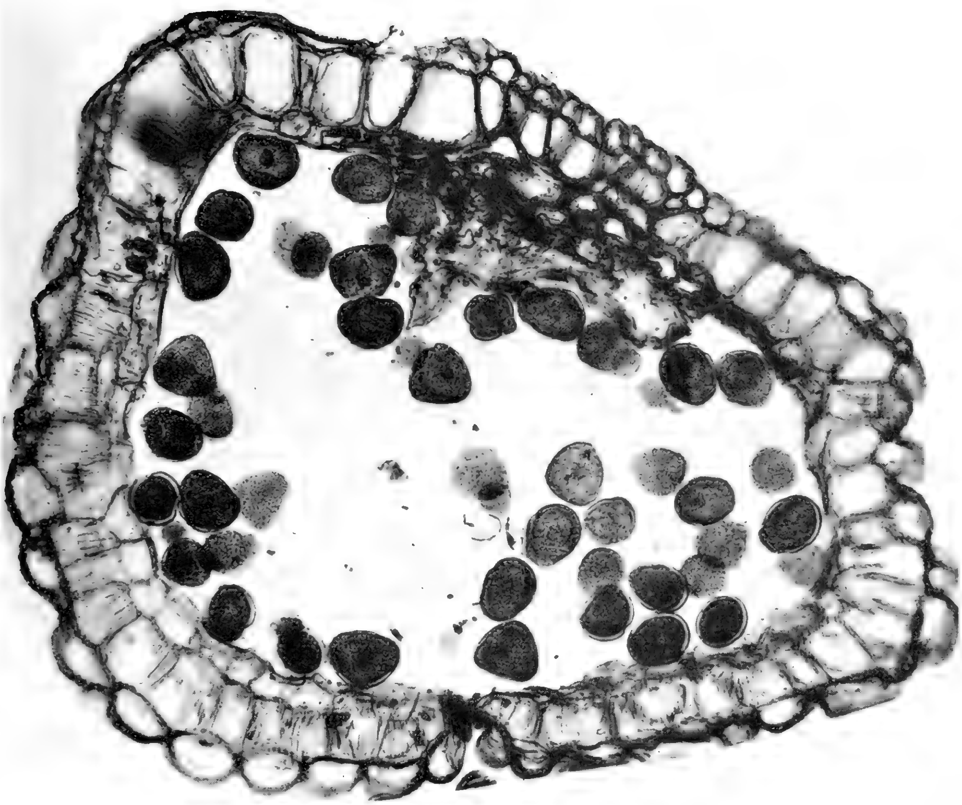
The question that headed his list was: "Why did not the systematic botanists discover the large number of species of Crataegus years ago?" The answers that he received were varied in the extreme. Sargent thought that their search was not sufficiently thorough; Ashe that they only used dry material; Beadle that their work was largely herbarium work; and Brainerd that they held in those days broader conceptions of what constituted a species.

The next question on Brown's list was: "Do you consider that the species now being described are elementary species?" The general consensus of opinion was that most of them were new species while some of them were mere fluctuations, and some were forms that have already been described and have escaped notice on account of the large numbers of new species in the genus.

SAID TO BREED TRUE

For his next question Brown asked: "Do these species breed true?" Sargent had planted over 3,000 numbers of seeds, and so far had found no evidence that they did not; the others agreed

[1] The numbers in parentheses refer to the list of authors cited at the end of this paper.



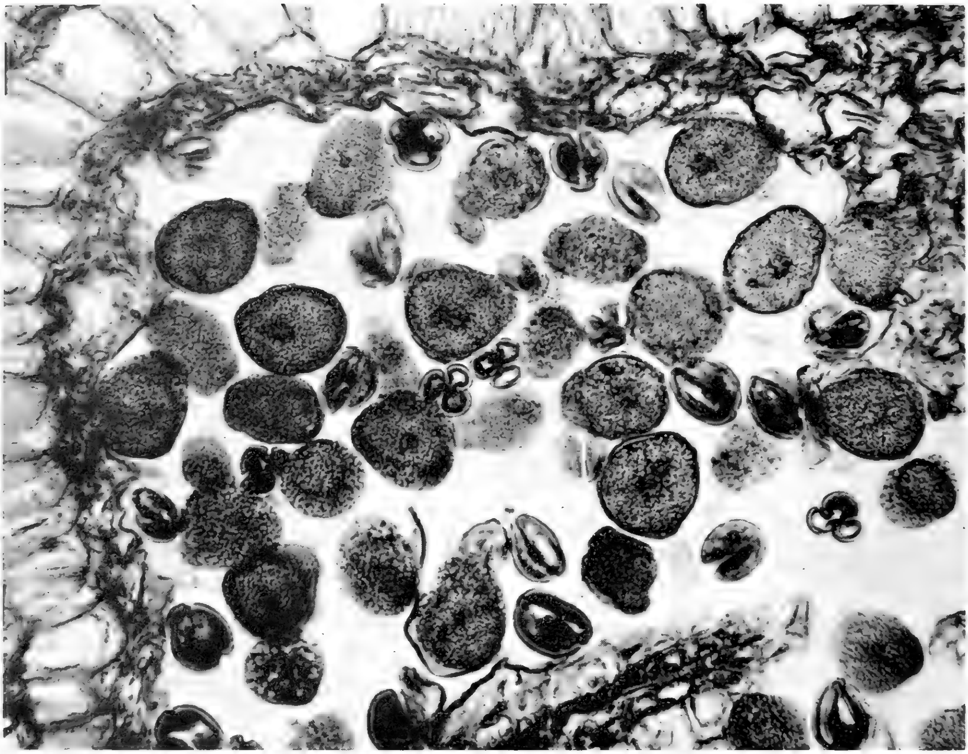
PERFECT DEVELOPMENT OF POLLEN

View of pollen sack of *Crataegus coccinea*, a hawthorn whose pollen shows no signs of sterility, practically every grain being perfect. (Fig. 7.)

that they did, although Brainerd had had no personal experience in raising them from the seed.

As to the question, "Will the different species hybridize?" Sargent had seen no evidence of it; Ashe thought that many did, and that "doubtless some of those called species are hybrids."(1). He did not think, however, that these hybrid forms were any more numerous in this genus than among the nearly related species of oaks. Beadle and Eggleston thought that they probably did, and Brainerd, although he had never hybridized any himself, knew of many cases that appeared to be natural hybrids—"local species, each quite intermediate between the supposed parents with which it is associated" (1). Dunbar had seen no evidence of hybridizing, but thought it very possible.

The last question as to whether the new species had arisen as mutations brought out extremely varied opinions. Sargent did not answer the question; Beadle thought that they had; Eggleston that some were hybrids and some were mutants; Ashe that probably some were mutants—"some of the forms in the Molles group in Missouri and Illinois would seem to be mutations leading to the inference that some of the species in this group may have originated in this manner. The variations in the Pruinosae in the Appalachians, and the localized valley species also indicate mutation origin" (1). Brainerd thought that there might be mutants, but it would be very hard to prove, and



A MIXTURE OF GOOD AND BAD POLLEN

Section of a pollen sack which may represent any one of a very large number of forms of Crataegus. Part of the grains are perfectly formed, the rest are shriveled or empty. This is the usual condition of pollen in hybrid plants, and is one indication that many of the North American hawthorns are hybrids. (Fig. 8.)

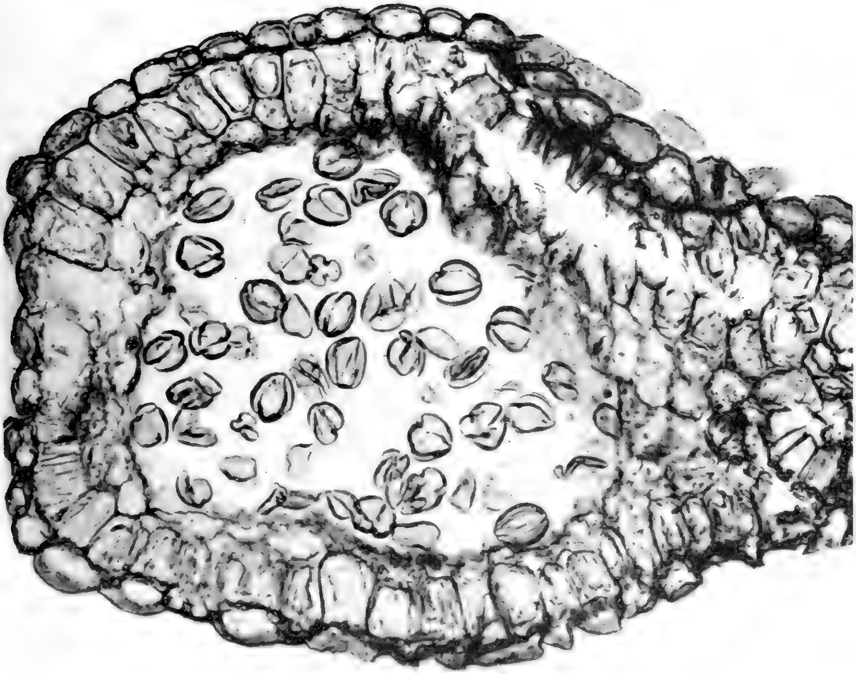
Dunbar believed in the Darwinian view of gradual change in evolution.

In the midst of so much conflicting opinion there seems to be one point on which all the authorities agree, and that is the extreme variability of the genus. Sargent alone during the last twenty years has numbered his new forms up into the thousands, and the process of multiplication appears to be still going on.

Unusual variability in plants is generally considered good evidence of hybridism, and it is more than probable that the hawthorns of the United States share with the European species in particular, and with the other Rosaceae in general, a marked disposition to hybridize. Luther Burbank has, as it were, specialized in producing variations by means of crossing; and his work, done on such a wholesale scale, is based on the principle that hybridism breaks up the continuity of inherited characteristics and results in the appearance of variations.

EVIDENCE FROM STERILITY

For further and more exact evidence we can turn to the morphological peculiarities of hybrids. Partial or complete sterility is and has long been recognized as an important basis of distinction between crosses and genetically pure species. To be sure, when the parent forms show a considerable degree of compatibility, the fertility of the offspring may be practically normal or even entirely so. Then again sterility may be largely eliminated by selection; but it is not present except when crossing is possible, it does not occur in monotypic species, and it is absent in genera that are isolated either geo-



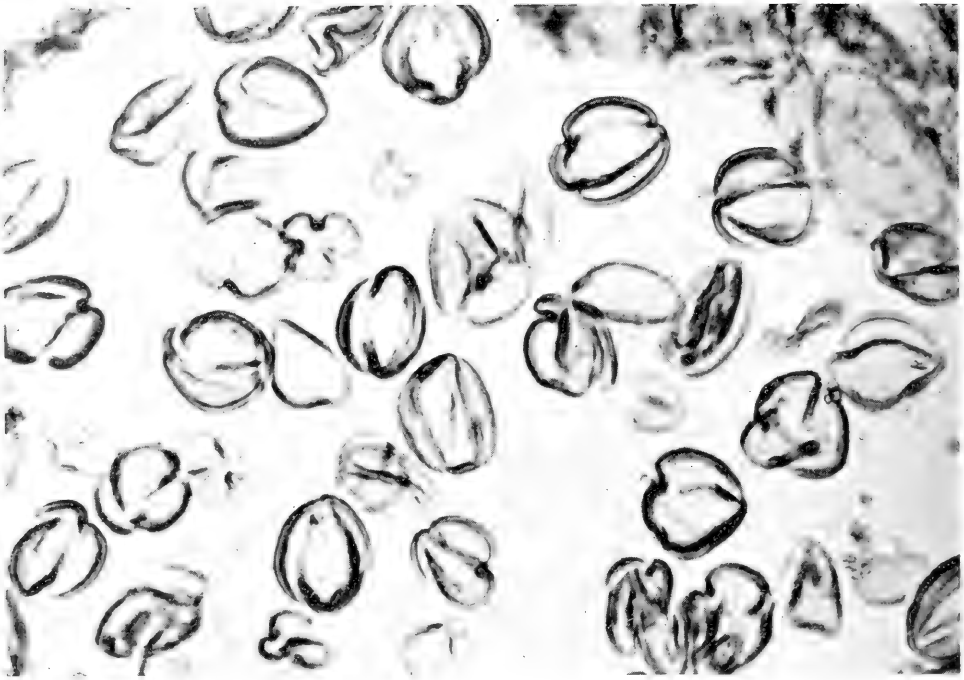
TOTAL LACK OF GOOD POLLEN

Longitudinal section of pollen sack of a hawthorn numbered 317 by Professor Sargent. Every grain in sight is shriveled or empty; there is not one which is capable of germination. Such a condition is frequently found in hybrid plants. (Fig. 9.)

graphically or phenologically (2). The sum of the evidence seems to point just one way—when absent the plant may or may not be of hybrid origin; but when pollen sterility is present, we have a clear indication of mixed ancestry.

Thus, morphologically we have a simple means of determining the purity of a species—often otherwise a difficult matter in the diagnosis of constant or relatively constant hybrids. And these constant hybrids are by no means as infrequent as we have grown to believe. Burbank's "Phenomenal," a cross between *Rubus fruticosus* and *Rubus idaeus*,[2] is as constant as the purest species (3). The hybrid alfalfa (*Medicago media*), a combination of the common purple alfalfa and the yellow *Medicago falcata*, is one of the oldest known hybrid races (3). It has been constant from the beginning as was proved when the cross was repeated by Urban. In the genus Anemone, Janczewski obtained the same results. He found that some characters would split, but that others would remain constant; and that when only such were present, hybrid races with new combinations of characters resulted which were as constant as the best species of the same genus (3). As far as I know no morphological study has been made of the pollen of these crosses, but they were quite fertile enough to reproduce themselves without any appreciable diminution in number. If found in the wild state, they would have been described

[2] This is practically the same as the loganberry, a hybrid which is now being widely grown on the Pacific Coast, and which appeared as a natural hybrid between a blackberry and red raspberry. Evidence as to whether the loganberry breeds true from seed is conflicting; certainly it does not always do so.



A BAD LOT OF POLLEN GRAINS

The hawthorn numbered "417 S. L.," seems not to have produced a single grain of pollen that was good for anything. Those shown here are all shriveled and imperfect. (Fig. 10.)

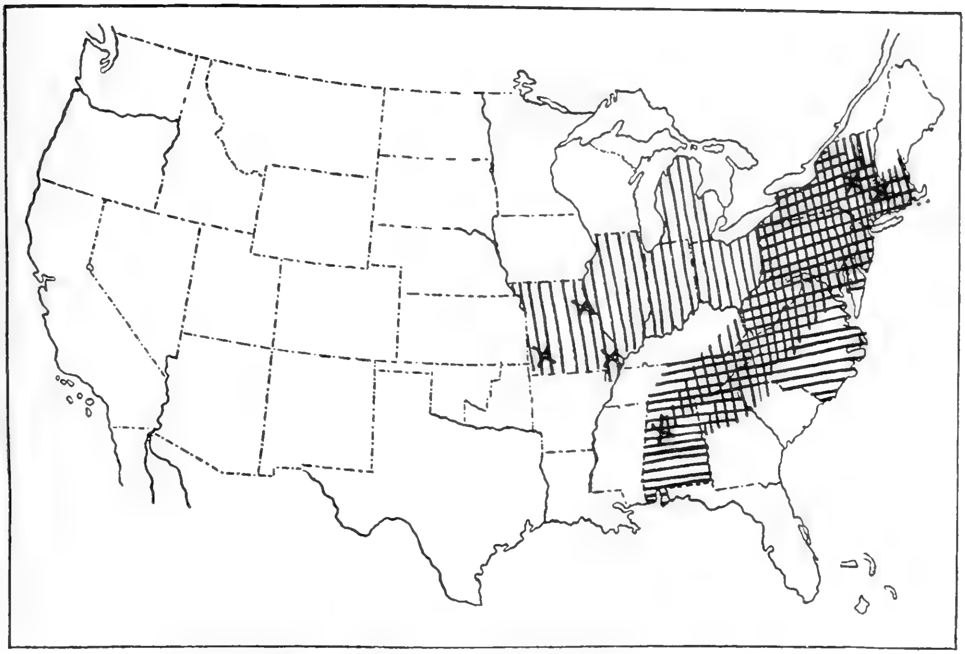
as species on a par with their parents. Such is particularly the case of the cross between *Anemone magellanica* and the common *Anemone sylvestris*.

As I have already mentioned, hybrids may have all degrees of pollen sterility from no appreciable amount to complete abortion of the grains. The hybrid *Aegilops speltiformis* is a very interesting constant race which is sufficiently fertile to propagate itself (3). It was formerly believed by Fabre and others to be a transition from some wild species of grass to the ordinary wheat—not a cross but a transition. Godron was successful in producing it artificially, however, and found it to remain constant. He discovered that although the hybrid between *Aegilops ovata*—a small weed—and the common wheat is of itself sterile and produces no good pollen, when this in turn was fertilized by the pollen of the common wheat, it gave rise to a secondary hybrid which is no other than *Aegilops speltiformis*.

Linaria italica—a hybrid toad-flax between *Linaria genistifolia* and *Linaria vulgaris* which has been repeated by De Vries in his own garden (3), is so sterile that it has to be cross-pollinated before it will give its normal yield of seed.

STERILITY AMONG THE HAWTHORNS

Among the Crataegi I found on microscopic examination that *Crataegus praeclara*—a species grown at the Arnold Arboretum, and not yet described as far as I know—is an example of complete abortion. It was found to contain no normal pollen grains. The anthers, which to all external appearance were robust and healthy, were found to be nearly devoid of contents. The anther sack or cavity was almost entirely filled up by the inner wall of cells which had apparently grown out into the sack instead of being absorbed as the pollen grains developed. As a matter of fact, the pollen grains did not develop



WHERE TWO GROUPS OF HAWTHORNS OVERLAP

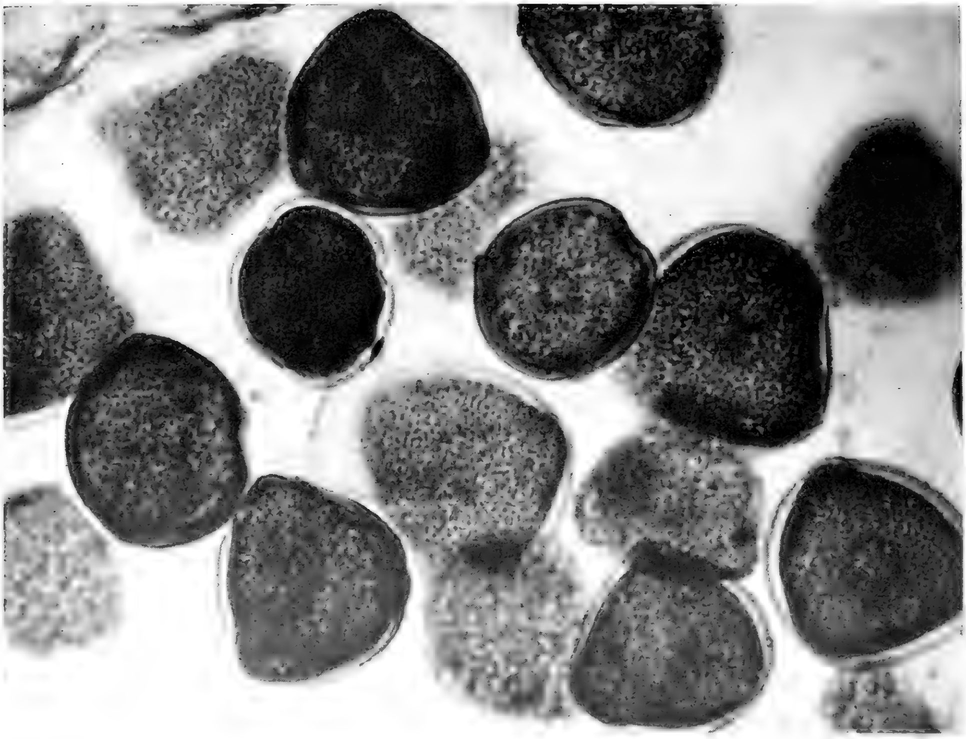
Area perpendicularly shaded indicates range of Coccineae, while area horizontally shaded indicates range of Intricatae. (Fig. 11.)

normally at all, but appeared to be collapsed and quite lacking in contents. After embedding the *C. praeclara* flowers in celloidin, and after staining the sections cut with hematoxylin and safranin, examination of the pollen grains showed them as irregularly elongated, brownish colored bodies—greatly in contrast to the triangular, opaque, and thoroughly stained normal grains that one would expect to find in a pure species. In cases of this nature, the plant must be cross-fertilized before it can propagate its kind.

Upon looking over 171 different forms of Crataegus, I found all degrees of pollen sterility. Thirty-five I classed as pure although many of them showed some grains of abortive pollen; sixty I classed as having from 10 to 50%; forty-one from 50 to 75%; and thirty-five from 75 to 100%.

As a result of an examination of the 171 specimens of Crataegus, I found the extraordinary state of affairs that roughly not quite one-fifth had normally developed pollen; while seventy-six (or within nine of one-half the total number) had between 50 and 75% sterile pollen. It is only fair to add that these species were largely among forms of such comparatively recent appearance that a considerable proportion of them have not yet been described. Out of the most sterile group (from 75 to 100%) twenty of the thirty-five species in the group could not be found in either Gray's New Manual or Sargent's Manual of the Shrubs and Trees of North America; thirty-five of the forty-one species in the next group (50 to 75%) and twenty-nine out of the group with normal pollen, had not been described in either of these manuals.

The Intricatae form one of the most interesting groups of the genus Crataegus: first because all the species of this class were once included in the Coccineae, before they were raised by Sargent to their present status; and second because an examination of the pollen of as many species as I could acquire among the two groups showed such contrasting results.



PERFECT POLLEN GRAINS, HIGHLY MAGNIFIED

The pollen grain is a single cell, enclosed in two transparent envelopes and consisting of a nucleus surrounded by nutritive material. The latter supplies nourishment for the growth of the pollen tube, down which the nucleus slips to unite with the ovule and thus start the growth of a new plant. The pollen here shown is that of *C. coccinea*. (Fig. 12.)

Gray ascribes to the Coccineae nine species and one variety of enough importance to constitute a paragraph. I was able to investigate the pollen of four forms: three of them species, namely, *C. anomala*, *C. Pringlei* and *C. pedicellata*; and the one variety, *C. coccinoides* var. *dilatata*. I also examined two more—one of which was to be found in Sargent and not in Gray, and one of which may not yet be described. These two were *C. delecta* and *C. flabellata*. I found that the pollen of all these forms was practically normal, never showing more than 10% abortive grains. I was unable to procure any of the local species of this group, but these, as can readily be seen on studying the following chart, are so situated geographically that they might easily be of hybrid origin.

Gray: Coccineae of Northeast Coast of U. S. A.

Montreal and Central Maine

1. *C. holmesiana*, south to Rhode Island and Pennsylvania, west to Michigan. In mountains to North Carolina *(var. *villipes*, south of Pennsylvania in mountains).
2. **C. anomala*, North Adams, Mass., and Albany, N. Y.
3. *C. cocc.* var. *dilatata*, south to Rhode Island, west to Missouri.

Northwest New England

1. *C. Pringlei*, south to Pennsylvania, west to northern Illinois.
   * (var. *exclusa*, Vermont and northeastern New York.)
   * (var. *lobulata*, Vermont and northeastern New York.)
2. *C. polita*, south to Delaware, west to Southern Michigan.

Middle Belt

1. *C. pedicellata*, South Connecticut, south to Pennsylvania and Delaware, west to southern Ontario and northern Illinois.
2. *C. coccinoides*, southwest Indiana to eastern Kansas, southwest Indiana to eastern Kansas.

POLLEN GRAINS OF C. COCCINEA

Two complete grains of pollen are here shown, enormously magnified. The dark patches in their centers are the nuclei, which are supposed to be the carriers of most, if not all, of the heredity; surrounding the nuclei is nutritive material. It will be noticed that the outer envelope of the grain is marked by thin spots, through which a pollen tube can easily break and grow down into the ovary of the plant to be fertilized. (Fig. 13.)

Missouri

1. * *C. Kellogii*, St. Louis, Mo.
2. * *C. lanuginosa*, Webb City, southwestern Missouri.
3. * *C. pyroformis*, southeastern Missouri.

Sargent: Middle Belt (Forms Not Listed in Gray)

1. * *C. Eamesii*, Connecticut, rich, moist soil.
2. * *C. Neo-Londonensis*, Connecticut, borders of woods.
3. * *C. Hillii*, northeastern Illinois, open woods, river banks, rich, moist soil.
4. * *C. assurgens*, northeastern Illinois, open woods, river banks, rich, moist soil.
5. * *C. acclivis*, northeastern Illinois, banks of rivers at Rochester and Niagara.
6. * *C. delecta*, northeastern Illinois, open pastures and wood borders.
7. * *C. sertata*, northeastern Illinois, open woods, rich, moist soil.

Note: Forms marked (*) are of purely local distribution.

The forms of the group as a whole are seen to be either of extremely wide range of distribution or they are extremely local; and these local forms never occur in an area not already covered by two or more of their more cosmopolitan cousins. These facts I consider significant. It is also of interest to note that all the new species recorded in Sargent but not in Gray and belonging to this group are confined to purely local distribution—two in Connecticut, and five in northeastern Illinois. I venture to guess that if the pollen of these forms were to be investigated, it would show a high percentage of sterility.

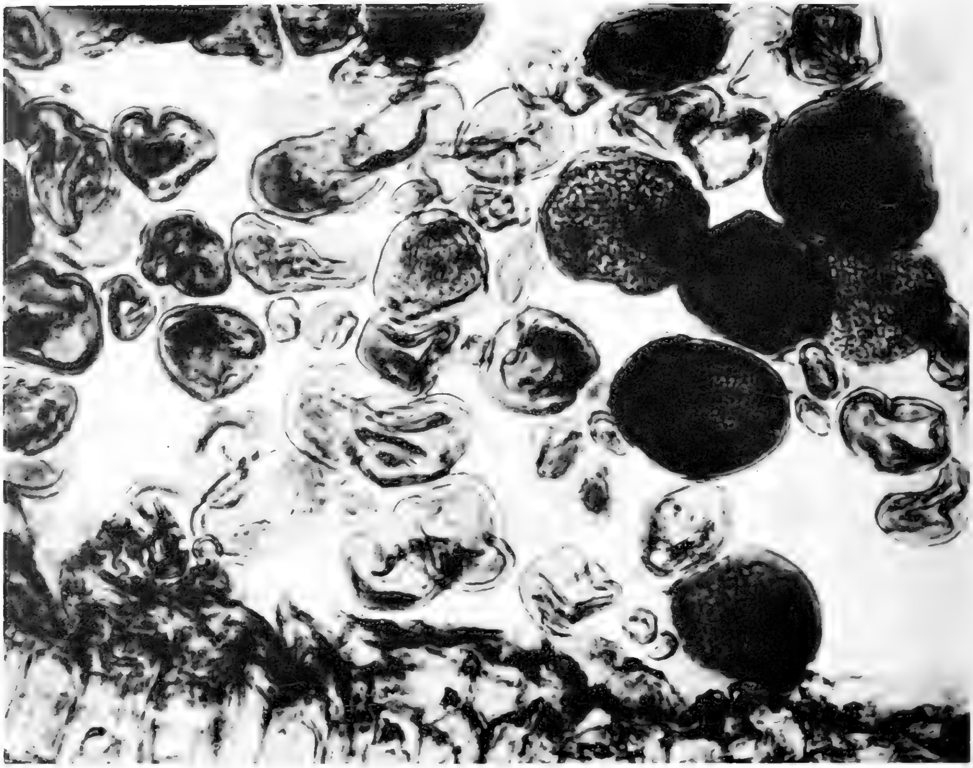
Examination of the pollen conditions of the Intricatae, on the other hand, proved them to be surprisingly sterile. Gray ascribes to the group six species and one variety. Of these seven forms I have investigated five:

C. Boyntoni.
C. foetida.
C. coccinea L.
C. apposita.
C. apposita, var. *Bisselli.*

Sargent describes three more forms not mentioned in Gray, and of these I was able to ascertain the pollen conditions of two:

C. Buckleyi. *C. venusta.*

Thus of the ten different forms that make up the Intricatae, I have looked into the spore conditions of seven and in no case have I found a flower that is not strikingly sterile. I was able to examine the pollen of one of the two extremely local species of the group—*C. venusta*, which is confined to the open oak and hickory woods on the dry



FEW GOOD, MANY WORTHLESS

Crataegus No. 367 S. L., showing a few perfect (dark) pollen grains and many shriveled (light), imperfect grains. Such a condition is regularly found in a great many plants of hybrid origin. The assumption is therefore worth testing, that the hawthorn which produces these is a hybrid and not a real species. (Fig. 14.)

slopes of Red Mountain in the southern part of Birmingham, Ala.—and I found it to be about 75% abortive. It is of interest to note among the Intricatae as well as among the Coccineae that the extremely local species only occur in localities already covered by other members of the group, and the same characteristic of overlapping in the range of distribution is evident.

Distribution Chart of the Intricatae: Gray

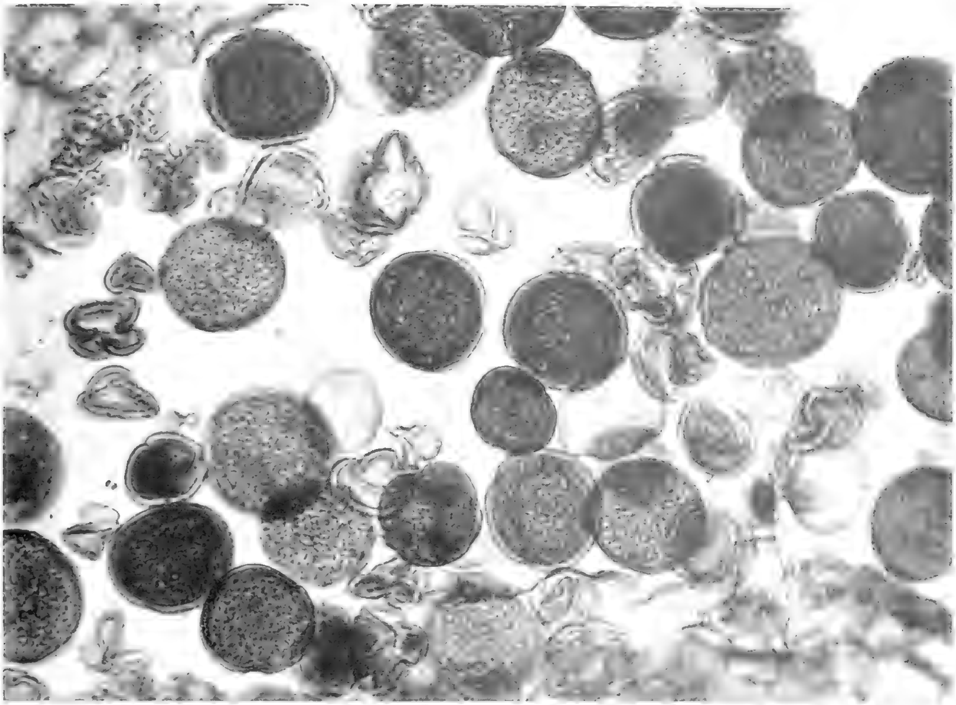
1. *C. coccinea* L., eastern Massachusetts to southwestern Vermont, southeastern New York, Pennsylvania, North Carolina, rocky woods.
2. *C. apposita*, Massachusetts and southwestern Vermont to New York, Virginia, rocky woods.
3. *C. apposita*, var. *Bisselli*, Massachusetts and southwestern Vermont to New York, Virginia, woods.
4. *C. Boyntoni*, Tennessee, Virginia, North Carolina, mountain woods.
5. *C. biltmoreana*, Virginia, North Carolina, mountain regions.
6. * *C. Stonei*, Central Massachusetts to Albany, N. Y.

Intricatae: Sargent (Forms Not Listed in Gray)

7. *C. Buckleyi*, Tennsessee, Virginia, mountain slopes.
8. *C. Sargenti*, northern Georgia, southern Tennessee, Alabama, woody bluffs.
9.* *C. venusta*, Red Mountains, Birmingham, Ala., woody slopes.

By means of the accompanying map (Fig. 11), I have tried to diagram the distribution of the Coccineae and of the Intricatae. The areas attributed to each group are bounded by the extreme limits of the various species in the group; while the local species I have indicated by crosses.

Although the map cannot bring out the overlapping of different species within the separate groups, it does show



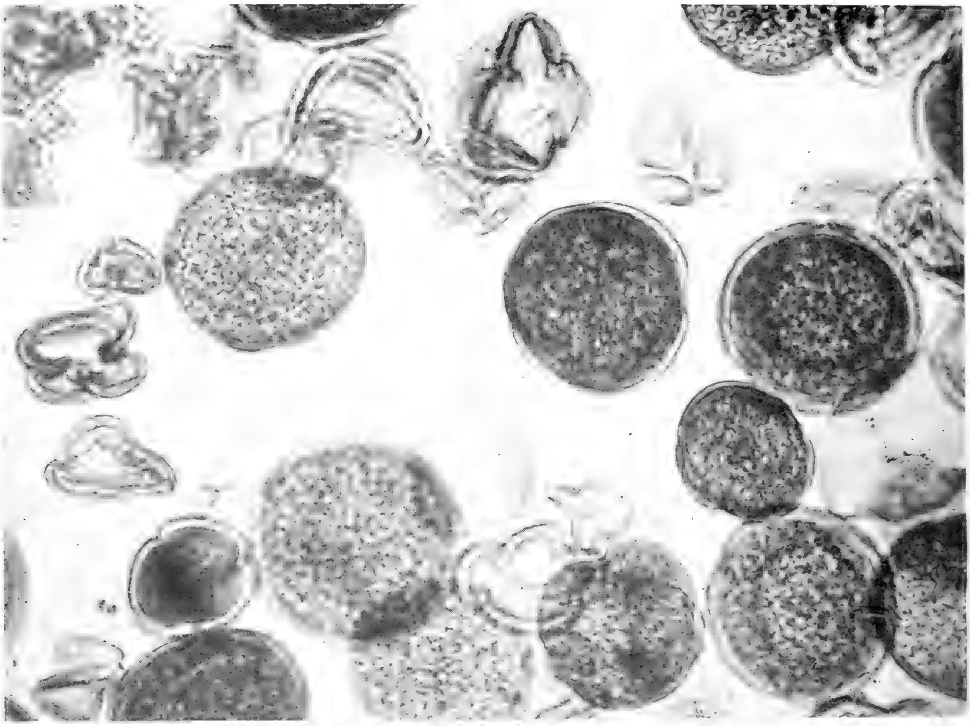
THE POLLEN OF CRATAEGUS HARBISONI

Perfect and imperfect grains seem to be present in about equal numbers. Although *C. Harbisoni* has been described as a good species, the condition of the pollen reminds one of such cases as the Velvet Bean artificial hybrids, where exactly one-half of the pollen was worthless. There is reason to suspect that "*C. Harbisoni*" and many other supposed species of hawthorn are not species at all, but natural hybrids. (Fig. 15.)

the overlapping in distribution areas of the two large groups. Massachusetts, southern Vermont, Connecticut, Rhode Island, New York, Pennsylvania and Delaware are states common to both the Coccineae and the Intricatae, as are also the mountainous regions south through Virginia, North Carolina, Tennessee and northern Georgia and Alabama.

It seems to me highly probable that the Intricatae—this group of comparatively new species which are also so closely allied to the Coccineae that the older systematic botanists included them under this last heading—may have an even closer relationship with them. Pollen sterility is a generally accepted characteristic of hybrids, and the Intricatae as a whole appear to share this trait with them. If crosses could be worked out with different species of the Coccineae for one or both of the parents, it would not surprise me if most of the Intricatae could be artificially produced. This, however, would be a long and tedious experiment owing to the years of maturation necessary before the hawthorns can bear seed. Nevertheless, from whatever stock the Intricatae may have sprung it seems to me very significant and a fact worthy of further study that the group as a whole is marked by such an extreme degree of sterility—a degree which is unusual even for the genus Crataegus.

The fact that *C. venusta* occurs only in the open oak and hickory woods on the dry slopes of Red Mountains near Birmingham, Ala., made the form of sufficient interest for me to look up the other forms of Crataegus which were native to the state. I found that in Alabama alone there were described in Small's second edition of his Manual of the Southern States, sixty-four species



THE POLLEN OF CRATAEGUS HARBISONI

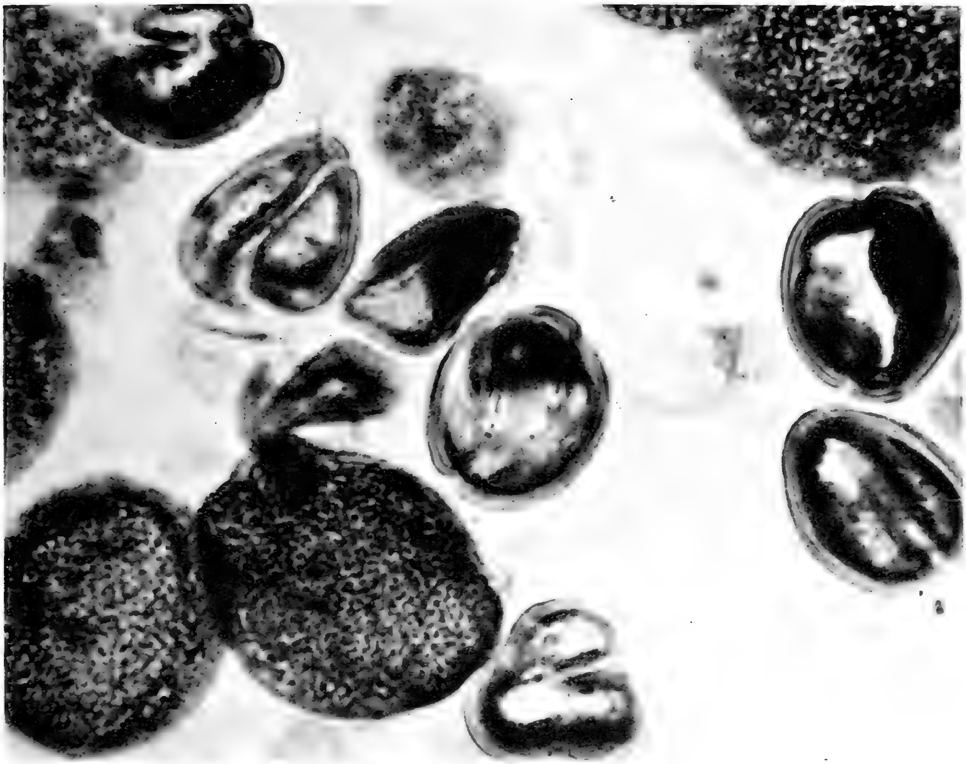
The pollen illustrated in Fig. 9 is here shown still more highly magnified. It will be seen that the empty grains fold up very neatly, their envelopes being provided with creases for that purposes. (Fig. 16.)

of which forty-two were strictly local in their distribution. Red Mountain being in northern central Alabama, I found that in this area, even when I limited the count to those forms which grew in upland woods, there were still thirty different species; and of these thirty, twenty-two were extremely local. Here again in the case of *C. venusta*, we seem to find ideal conditions for natural hybridization combined with a high degree of spore sterility.

In answer to Mr. Brown's question in regard to mutation in this genus, Ashe cites the Pruinosae and Molles groups as showing some indication of its presence. Since the Molles have only one of their species native to Massachusetts, I have made no study of them; but I was able to secure a number of the Pruinosae, and as to pollen sterility they seem to exemplify the conditions of the genus as a whole.

In Gray's Manual (1908) to the Pruinosae are ascribed six species and eight varieties of which all but *C. pruinosa* var. *dissona* and *C. pruinosa* var. *philadelphica* are considered close enough to species to constitute a separate paragraph. Varieties which are placed in this category are thought "so distinct and peculiar that they are not unlikely to establish the claim" and be considered species. In fact this prediction has largely come true; as of these eight varieties, Sargent describes seven as species and only one—var. *dissona*—as a true variety. The results of the investigation of the Pruinosae was as follows:

Sargent	*Gray*	*% of abortion*
C. cognata	var. *latisepala*	75
C. pruinosa	*C. pruinosa*	60
C. robbinsiana	var. *beckwithia*	50
C. deltoides	*C. deltoides*	50
C. fusca	var. *philadelphica*	40
C. conjuncta	var. *conjuncta*	practically pure
Forma dissona	*Forma dissona*	practically pure



CAN THIS BE A GOOD SPECIES?

Pollen grains of *Crataegus cognata*, highly magnified. A few of them are seen to be perfect, while an equal number are quite incapable of germination. If such a condition were found in the pollen of a single species, it might not attract great attention, but when hundreds of species, in the genus Crataegus, are found to have this kind of pollen, the botanist naturally inquires what has happened. (Fig. 17.)

Among the Pruinosae then, we find conditions much the same as in the rest of the genus—a relatively small proportion of the species showing normal pollen and more than half showing pollen markedly abortive. In view of the fact that unusual sterility and an unusual amount of variation are characteristic of hybrid races, the question of mutation among the Crataegi seems to resolve itself into a matter of hybridization; and in fact, this is the conclusion which Mr. Brown reaches even without this important morphological evidence.

In 1908 (1) he crossed the English hawthorn—*C. monogyna*—with the native *C. Brainerdi:* in 1909, he and William Moore made cross pollinations between the majority of the native species with the result that in all cases the fruit set and matured, to all external appearances entirely normal. The theory which he reached as a result of his investigation was that the enormous increase in the species of the genus is due to extensive hybridization since the dense forests have been cleared (2). The irregularity in the number of stamens and pistils, the variation in shape of leaves and color of anthers (from white to dark purple), the occurrence of plants with characteristics of two different species which grow in the near neighborhood, and the occurrence of numerous local species—one of which is peculiar to almost all of the states east of the Mississippi—all these facts in his opinion point to extensive hybridization. No sufficient tests have been

made, however, to prove beyond a doubt whether or not hybrids of Crataegus are stable—circumstantial evidence seems to indicate that they are, but no such extensive experiments in breeding as would be necessary have been attempted on account of the difficulties due to the slow maturation of the plant.

STUDY OF THE ROSE FAMILY

Since Mr. Brown's article in the Bulletin of the Torrey Botanical Club was published, nevertheless, work carried on in the Harvard laboratories under Prof. E. C. Jeffrey by C. S. Hoar on the raspberries, and by Miss R. D. Cole on the roses, and also my own examination of the hawthorns, have revealed among the Rosaceae a large number of hidden or crypthybrids which are constant in their character and which are recognized by systematic botanists as good species, but which may be distinguished from normal species by the sterility of their reproductive cells. These crypthybrids, while they are extremely important from the evolutionary standpoint on account of their enormous variability and the consequent multiplication of species, must nevertheless not be given credit for the origin of species. Although in answer to Mr. Brown's questions Ashe, Beadle and Eggleston appeared to favor the idea that at least some of the new species of Crataegus might be mutants, investigation of the morphological characteristics of the genus backs up Brainerd in his emphasis of the extraordinary tendency towards hybridization among the Rosaceae. I quote what he had to say on the subject (1).

"In Europe the few species [of Crataegus] cross in many ways (Focke's Pflanzen-mischlinge p. 146). I know of many cases which appear to be natural hybrids or local species each quite intermediate between the two supposed parents with which it is associated. The Rosaceae are of all others the most disposed to hybridize. I should expect the same in Crataegus as in Rosa, Rubus, Geum, Amelanchier and Malus. The condition in Crataegus is much like Rubus, Rosa and Viola. The multiplication of even stable forms that may result (in the working out of Mendel's laws) from one pair of parents is astonishing."

To summarize the evidence set forth in this paper, we find among the Crataegi an extraordinary amount of comparatively recent multiplication of forms; we find also, large numbers of local species combined with unusual sterility. Out of the 171 specimens examined only thirty-five could be considered uncontaminated with regard to pollen conditions, while seventy-six showed from 50 to 100% of abortive grains. Sterility partial or complete of the reproductive cells has long been recognized as a characteristic of hybridism; and forms which are ordinarily accepted as species frequently reveal past genetical contamination by pollen infertility. Among the Rosaceae, a family showing an unusually strong tendency to hybridize, examination of the pollen conditions discloses a great number of these hidden hybrids.

The Intricatae on account of their unique position seemed worthy of study in this connection. In the first place they are a relatively new group so closely allied to the Coccineae that they are included in the group as far as they were known to the older systematists. They show a smaller range of distribution both collectively and individually than do the Coccineae; they only occur in localities where there is a possibility of crossing; and they have a degree of sterility unusual even for the genus Crataegus. This seems a suspicious combination of facts. Investigation of the other groups in so far as I could get material, parallels the condition found in these two groups—that among the more widely distributed species the pollen is apt to be good, while in those of more local range the pollen is largely abortive. This evidence is exemplified by *C. venusta*—a form extremely local in its range and growing under circumstances ideal for cross fertilization—which proved to be 75% sterile.

The study of this genus has brought out evidence of both systematic and morphological character to indicate the

wide-spread occurrence of hybridism; and in conclusion I think we must face the fact that among the Crataegi at least extreme variability is linked with extensive hybridization and the consequent multiplication of species, rather than with mutation and the problem of the saltatory origin of species.[3]

[3] The material for this study was collected at the Arnold Arboretum, and I wish to express my thanks to Prof. C. S. Sargent for this courtesy. I am also indebted to Prof. E. C. Jeffrey, in whose laboratory this study was made, for the use of his apparatus as well as for his advice and criticism.

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The Relation of Vigor to Heredity

VIGOR AND HEREDITY, by J. Lewis Bonhote. Pp. 264, illus., price 10*s.* 6*d.* net. London, Adlard & Son and West Newman, 1915.

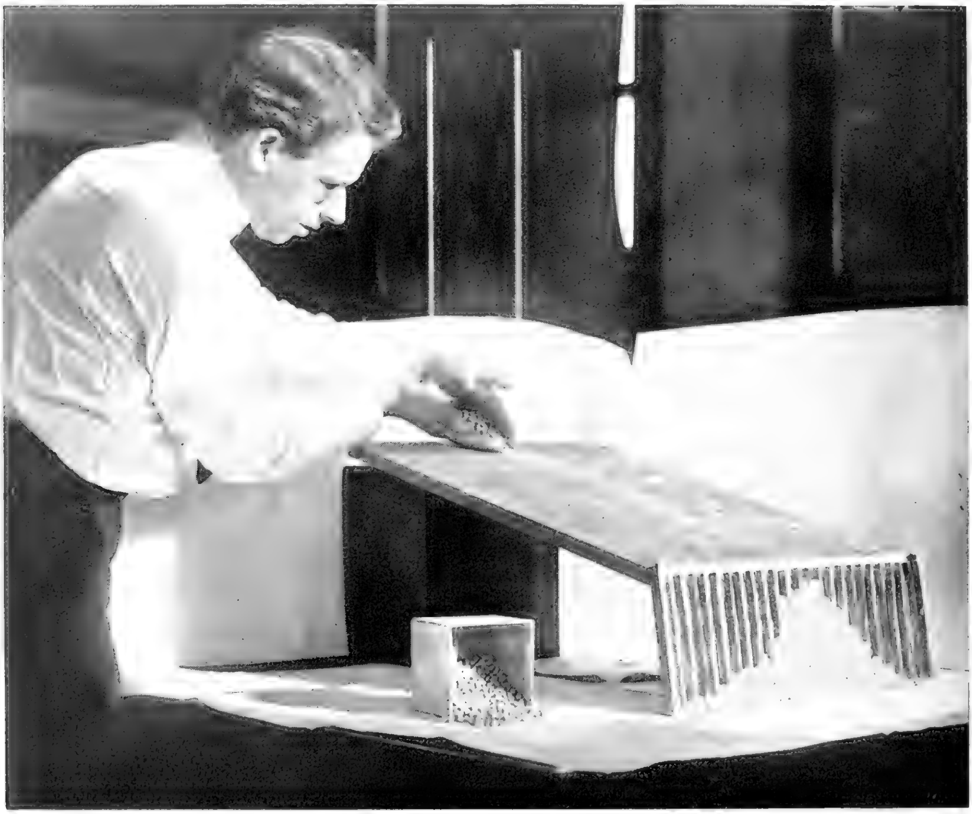
Geneticists have been so carried away with the idea that characters are unchangeable that some of them have given little study to the modifying effects of outside influences on the expression of inherited traits. Mr. Bonhote thinks they have made a fundamental mistake, and asserts that not only is the expression of a Mendelian character—its dominance or lack of dominance, for example—largely dependent on vigor, but that new variations arise from that cause. Furthermore, he believes vigor to be inherited, and has carried on breeding experiments to demonstrate it. His method of measuring an animal's vigor by its color is not the most accurate conceivable, but he draws some highly interesting generalizations from his experiments and from extended observations on species in the wild. His controlled evidence is limited in extent and great weight cannot be placed on it, but the book is at least highly suggestive and ought to lead to a broader view of heredity than is now held by many experimental biologists.

An Elementary Text-Book on Evolution

EVOLUTION, HEREDITY AND EUGENICS, by John Merle Coulter, professor of Botany in the University of Chicago. Pp. 133, illus., price 50 cents. School Science Series No. 5, John Coulter, publisher, Bloomington, Ill., 1916.

"The thinking of today that is most significant is thinking in terms of evolution. Intelligent interpretation of life depends upon it," says Professor Coulter. "Yet it is a fact that the 'average citizen' has but the vaguest ideas of what evolution is." He has therefore undertaken to give definite ideas in a little book adapted for use by high school and college classes in elementary biology. The great extent of ground to be covered necessarily involves a summary and dogmatic method of treatment. The four pages allotted to eugenics are particularly inadequate.

VARIABILITY CURVE FOLLOWING LAW OF CHANCE



Photograph of beans rolling down an inclined plane and accumulating in compartments at the base which are closed in front by glass. The exposure was long enough to cause the moving beans to appear as caterpillar-like objects hopping along the board. If we assume that the irregularity of shape of the beans is such that each may make jumps either toward the right or toward the left in rolling down the board, the laws of chance lead us to expect that in very few cases will these jumps be all in the same direction as indicated by the few beans collected in the compartments at the extreme right and left. Rather the beans will tend to jump in both right and left directions, the most probable condition being that in which the beans make an equal number of jumps to the right and to the left as shown by the large number accumulated in the central compartment. If the board be tilted to one side, the curve of beans would be altered by this one-sided influence. In like fashion a series of factors—either of environment or of heredity—if acting equally in both favorable and unfavorable directions, will cause a collection of ears of corn to assume a similar variability curve when classified according to their relative size. Such curves are used by biometricians in classifying and studying variations in plants and animals. Photograph by A. F. Blakeslee, Carnegie Station for Experimental Evolution, Cold Spring Harbor, L. I. (Fig. 18.)

LAUGHING AND CRYING

What Is Their Use?—Probably Safety Valve for the Body When It Is Affected by Emotions—Their Evolutionary Origin

WHY do you laugh when a man slips on a banana-peel?

Great philosophers have pondered on the problem. Spencer and Bergson have tried to explain it. The latest discussion, and one of interest and lucidity, is that of Dr. George W. Crile.[1] He starts with the assumption that the habit of laughing must be of some use to the race, and then he undertakes to show what this use is.

As a preliminary, we must understand just what we mean, physiologically, by laughter. It is "an involuntary rhythmic contraction of certain respiratory muscles, usually accompanied by certain vocal sounds. It is a motor act of the respiratory apparatus primarily, although if intense it may involve not only the extraordinary muscles of respiration, but most of the muscles of the body. There are many degrees of laughter, from the mere brightening of the eyes, a fleeting smile, tittering and giggling, to hysteric and convulsive laughter. Under certain circumstances, laughter may be so intense and so long-continued that it leads to considerable exhaustion."

"What causes laughter? Good news, high spirits, tickling, hearing and seeing others laugh; droll stories; flashes of wit; passages of humor; averted injury; threatened breach of the conventions; and numerous other causes might be added. It is obvious that laughter may be produced by diverse influences, many of which are so unlike each other that it would seem at first sight improbable that a single general principle underlies all."

If we are to find a general principle, we must proceed from some elementary facts. Man, Dr. Crile tells us, is "essentially a motor being." He is organized for action. The sight of a mad dog, let us say, tends to produce action in the beholder; the body automatically gets ready to run or to fight. These various responses of the body to this situation probably occur before the man himself has realized the situation, and the emotion of fear which is aroused in him results, it is supposed, from the activities of the body in preparing for retreat or defense.

Not only are the brain-cells stimulated by the sight of the mad dog, but the ductless glands at once set to work to pour into the circulation their energizing secretions, thus putting the body in a position to meet the unusual demands made on it. In other words, an emotion (say, fear) is accompanied, or perhaps the result of, the preparation of the body for unusual action. If the action takes place, the fuel which has been released, the sources of energy which have been made available,[2] are used up, and the body returns to its normal condition.

NECESSITY FOR ACTION

But suppose that no action follows the emotion—what happens? The blood is full of "emergency rations," which are not needed and which therefore have to be eliminated as waste products, thus putting a tax on the system. That is why emotion unaccompanied by muscular action, is more injurious to the body than is muscular action alone.

Suppose, then, that one were so impelled to anger that he got in fighting mood, and wanted to hit somebody. He might pursue three courses:

1. He might perform no physical act,

[1] Crile, George W., "The Origin and Nature of the Emotions." Philadelphia, W. B. Saunders Co., 1915.

[2] "Epinephrin, thyroid and hypophyseal secretions are thrown into the blood streams, while that most available fuel, glycogen, is also mobilized in the blood."

MAN IS NOT THE ONLY PRIMATE WHO LAUGHS

Darwin long ago pointed out that the great apes shared with man the habit of laughing when pleased, or when tickled. The photograph above, from Underwood and Underwood, shows Mike, the clever chimpanzee in the London zoo; Dr. Crile considers that he is laughing although, according to Darwin, the chimpanzee does not ordinarily put so much heart in it, but contents himself with grins and chuckles. (Fig. 19.)

but merely give expression to the emotion of anger. This would, for the reasons pointed out above, be distinctly injurious to him.

2. He might hand his coat to the nearest innocent bystander, roll up his sleeves, and "let go" with the result, if the other man were not too big, that he would completely satisfy his anger and return to normal.

3. He might immediately turn and run around the block, or engage in some other violent exercise. This would consume all the motor-producing elements mobilized by the body and, again, would leave him normal.

It is not proposed, from these statements, to insist on the moral that you should fight every time you get hot under the collar, but merely to point out that when a strong emotion is not followed by some physical action, the body suffers.

Now laughter consists of physical action, of muscular exertion. It serves, Dr. Crile says, "precisely such clarifying purposes as would be served by the gymnastic exercises of an angry man. As it seems to me, the muscular action of laughter clears the system of the energizing substances which have been mobilized in various parts of the body for the performance of other actions.

"If this be true, the first question that presents itself is, 'Why is the respiratory system utilized for such a clarifying purpose? Why do we not laugh with our hands and feet as well?' "

The answer seems to him obvious. Were laughter expressed by the hands the monkey, who shares with man the privilege of a hearty laugh, would fall from the tree. Were it expressed with the feet, a man would either fall down or be temporarily "crippled." The muscles of the face and chest seem to be the most available ones at liberty to perform this action, since they do not incapacitate the subject for any other action that may be useful to him. It may be supposed, then, that in the course of evolution, natural selection has picked out these muscles and fixed on them the duty of relieving a man of the effects of his emotions, by the exercise which we call laughing.

"Let us test this hypothesis by some practical examples. The first is an incident that accidentally occurred in our laboratory during experiments on fear which were performed as follows: A keen, snappy, fox-terrier was completely muzzled by winding a broad strip of adhesive plaster around his jaw so as to include all but the nostrils. When this aggressive little terrier and a rabbit found themselves in close quarters each animal became completely governed by instinct; the rabbit crouched in fear, while the terrier, with all the ancestral assurance of seizing his prey, rushed upon the rabbit, his muzzle always glancing off and his attack ending in awkward failure.

"This experiment was repeated many times and each time provoked the serious-minded scientific visitors who witnessed it to laughter. Why? Because the spectacle of a savage little terrier rushing upon an innocent rabbit as if to mangle it integrated the body of the onlooker with a strong desire to exert muscular action to prevent the cruelty. This integration caused a conversion of the potential energy in the brain-cells into kinetic energy, and there resulted a discharge into the blood-stream of activating internal secretions for the purpose of producing muscular action. Instantly and unexpectedly the danger passed and the preparation for muscular action intended for use in the protection of the rabbit was not needed. This fuel was consumed by the neutral muscular action of laughter, which thus afforded relief.

"A common example of the same nature is that encountered on the street when a pedestrian slips on a banana peel and, just as he is about to tumble, recovers his equilibrium. The onlookers secure relief from the integration to run to his rescue by laughing. On the other hand, should the same pedestrian fall and fracture his skull the motor integration of the onlookers would be consumed by rendering physical assistance—hence there would be no laughter."

THE EFFECT OF A JOKE

Dr. Crile attempts to apply this view to laughter produced by a joke. Jokes, he says, consist of two parts; in the first, the reader's emotion is stirred by the presentation of some situation which seems to call for action, and in the second he is suddenly shown that he has been hoaxed, that it is a false alarm. This element of incongruity has long been recognized as the basis of much humor, and in so far as it is, Dr. Crile's explanation will in many cases cover the resulting laughter. Other cases may be explained as association of ideas. Obviously, however, there must be ramifications of the subject, and some of them were ingeniously explained by Herbert Spencer, whose discussion of laughter is in many ways like that of Dr. Crile, although the latter has the advantage of much work in physiology which has been done since Spencer's time. The philosopher offers[3] this case:

"You are sitting in a theater, absorbed in the progress of an interesting drama. Some climax has been reached which has aroused your sympathies—say, a reconciliation between the hero and heroine, after long and painful misunderstanding. The feelings excited by this scene are not of a kind from which you seek relief; but are, on the contrary, a grateful relief from the painful feelings with which you have witnessed the previous estrangement. Moreover, the sentiments these fictitious personages

[3] Spencer, Herbert, "The Physiology of Laughter." In "Illustrations of Universal Progress" (New York, 1872), p. 203.

TEARS ARE OF GREAT VALUE TO THE RACE

They may not always be appreciated by the individual, or the individual's parents, but historically, according to Dr. Crile, they act as a safety valve for the body, just as laughter does. When a strong emotion is felt, the blood is filled with substances intended to be used in muscular action. If no action follows, the blood is overloaded, and this surplus fuel would have to be eliminated as waste matter, at considerable expense to the system. But either laughing or crying will take the place, to some extent, of more violent physical action, and use up the "emergency ration" which otherwise, to speak figuratively, would cause indigestion. Photograph from the Nursery Studio, Washington, D. C. (Fig. 20.)

have for the moment inspired you with, are not such as would lead you to rejoice in any indignity offered them; but rather, such as would make you resent the indignity. And now, while you are contemplating the reconciliation with a pleasurable sympathy, there appears from behind the scenes a tame kid, which, having stared round at the audience, walks up to the lovers and sniffs at them. You cannot help joining in the roar which greets this *contretemps*. Inexplicable as is this irresistible burst on the hypothesis of a pleasure in escaping from mental restraint; or on the hypothesis of a pleasure from relative increase in self-importance, when witnessing the humiliation of others; it is readily explicable if we consider what, in such a case, must become of the feeling that existed at the moment the incongruity arose. A large mass of emotion had been produced; or, to speak in physiological language, a large portion of the nervous system was in a state of tension. There was also great expectation with respect to the further evolution of the scene—a quantity of vague, nascent thought and emotion, into which the existing quantity of thought and emotion was about to pass.

A DIVERSION OF ENERGY

"Had there been no interruption, the body of new ideas and feelings next excited, would have sufficed to absorb the whole of the liberated nervous energy. But now, this large amount of nervous energy, instead of being allowed to expend itself in producing an equivalent amount of new thoughts and emotions which were nascent, is suddenly checked in its flow. The channels along which the discharge was about to take place, are closed. The new channel opened—that afforded by the appearance and proceedings of the kid—is a small one; the ideas and feelings suggested are not numerous and massive enough to carry off the nervous energy to be expended. The excess must therefore discharge itself in some other direction; and in the way already explained, there results an efflux through the motor nerves to various classes of the muscles, producing the half-convulsive actions we term laughter."

As he goes on to point out, this line of explanation (properly modified in the light of more recent psychology) will explain the fact that, in a group of persons, some will laugh at a given incident and others will not. It is, in some cases at least, because the amount of emotion present varied in the different persons; some required physical action to relieve their feelings; others had no feelings to relieve.

In sum, then, we know that, in emotion, the ductless glands at once pour out an unusual amount of secretions, to prepare the body for an emergency that is supposed to be near. These secretions cannot be recalled; and if the emergency does not bring physical action to use them up, they must be burned up as waste material, at some expense to the bodily mechanism. To obviate this, the muscular activity of laughter has therefore been evolved to use up these surplus fuels, when they are not needed for the purpose for which they were produced; and thus the body is relieved of them without any damage.

"Crying, like laughter," Dr. Crile continues, "is always preceded by a stimulation to some motor action which may or may not be performed. If a mother is anxiously watching the course of a serious illness of her child and if, in caring for it, she is stimulated to the utmost to perform motor acts, she will continue in a state of motor tenseness until the child recovers or dies. If relief is sudden, as in a crisis of pneumonia, and the mother is not exhausted, she will easily laugh; if tired, she may cry. If death occurs, the stimulus to motor acts is suddenly withdrawn and she then cries aloud, and performs many motor acts as a result of the intense stimulus to motor activity which is no longer needed in the physical care of her child. With this clue we can find the explanation of many phenomena. We can understand why laughter and crying are so frequently interchangeable; why they often blend and why either gives a sense of relief."

Laughter and crying, in short, are two forms of the same mechanism—a human safety valve to prevent the results of emotion from injuring the body.

REDFIELD EXPLAINS AND BROADENS HIS OFFER OF $1,000

IN THE JOURNAL OF HEREDITY for February, 1916, was published my offer of $1,000 for data on heredity. The offer was divided into five parts as follows:

1. An offer of $200 for any intellectually superior person produced by breeding which was more rapid than four generations in a century.

2. Another $200 for any very superior person produced by breeding which was more rapid than three generations in a century.

3. Another $200 for any case of improvement in the work-performing capabilities of any kind of animal which was not preceded by the performance of an unusual amount of work performed before reproducing by the three preceding generations.

4. Another $200 for any case of a decline in work-performing capabilities failing to follow a deficiency of work performed in preceding generations.

5. Another $200 for any group of animals in which the work-performing capabilities of the individuals of which were not proportional to the amount of work performed by their immediate ancestors (three generations) before reproducing.

From a number of letters received it appears that the terms of the offer seem indefinite or ambiguous to many persons. For the benefit of such I am furnishing the following explanations and observations.

The first thing to consider is the distinction between a foot-pound and a cubic foot. Biological teaching has been concerned principally with the class of things measured by the cubic foot or corresponding unit. The offer relates to the class of things measured by the foot-pound or corresponding unit.

A sick man does not hire his physician by the cubic foot. He hires him for his foot-pounds of intelligence. This is not to say that intelligence is ordinarily measured by the foot-pound, but it is to point out that intelligence belongs in that class of things measured by the foot-pound type of unit, and not in the class measured by the cubic foot type.

A horse-power derived from a horse does not differ from a horse-power derived from a steam engine. The result of a mathematical calculation performed by the human intelligence does not differ from the result of the same calculation performed by a calculating machine driven by a motor. Many automatic machines operated by mechanical power perform the identical work performed by the human intelligence and the human hand.

HEAT THE SOURCE OF POWER

A man can move and think only because of heat units derived from food. Shut off the supply of heat units and the animal dies. The germ can exist and go into the reproductive process only because of the heat units it receives. Shut off the heat units and heredity ceases to operate. Heat units are the source of mechanical power.

The above observations are for the purpose of pointing out that human intelligence, and animal powers of all kinds, have the same origin as mechanical power, and are transformable into the same work. Animal energy is identical with mechanical energy.

There are certain laws relating to energy, which laws are definite and precise things in science. My offer raises the question of a conflict between present biological teaching and the presumably indisputable laws of another science. The last three sections of my offer were carefully worded with those laws in mind, and on the assumption that those laws are absolutely rigid for all forms of energy.

All of my writings on this subject,

from 1902 to the present time, have been directed to showing that the energy found in animals is identical with the energy known in mechanics, and responds on test to the laws that govern all other forms of energy known to science. As those laws can operate from one generation to the next only through the inheritance of acquirements, my writings have been directed mainly to that essential and disputed point.

I have published the results of my investigations into some thousands of cases. On many occasions for more than ten years there have been complaints because I did not also give contrary cases, that is, cases which showed that Nature violated her own laws. I have never found any such, but for the benefit of those who think that she actually does do so, there is my offer of $1,000. As stated, the offer requires the evidence to be in a particular form, but I now broaden out the offer by saying that any evidence of any kind or description which will cause the American Genetic Association to declare officially that the known laws of energy are not valid when applied to energy in the living animals, will capture the money.

IS EVOLUTION POSSIBLE?

A parent cannot transmit what he does not have. If he can transmit no more than he inherited, how can there be an evolution (increase) of animal power from generation to generation? If it be assumed that such increases of power capabilities might come by mutation or advantageous variation, then we would have the case of an offspring born with something it did not inherit from its parents. That would mean that an act of special creation had taken place, or that the laws of energy had been violated in some way in the reproductive process. I will again broaden the offer by saying that any evidence of any kind or description which will cause the American Genetic Association officially to declare that the laws of energy can be valid in the living animal from generation to generation and yet not involve the inheritance of acquirements, will capture the money.

In Dynamic Evolution I have given a brief statement of the laws of energy, and the manner of applying them to the energy in animals. For a more comprehensive understanding of energy and the laws relating thereto, reference must be had to text-books on physics, or to those parts of books on mechanics or engineering which treat of power production and power distribution. Reference may also be had to articles on "Energy" and "Energetics" in Encyclopedia Brittanica, last edition. See also "Energy" and "Thermodynamics" in Cyclopedia Americana.

C. L. REDFIELD,
Chicago, Ill.

Left-handedness

The latest contribution to the much-discussed and little understood problem of left-handedness is that of Dr. Franz Schwerz in the *Archiv für Rassen- und Gesellschafts-Biologie*, XI, 3, pp. 299–314. He finds the statistics of its frequency conflicting: Hasse and Dehner, who examined 5,141 German soldiers, found the left-handed to be 1%; Stier's figures for East Prussia are 2.32%, for Württemburg 6.5%; the author found in 1,072 Schaffhausen school children 7.9%. It is not certain whether the abnormality is more common among boys or girls. Schwerz alludes to the idea that left-handedness is to be classed as one of the "stigmata of degeneracy," and accepts the old belief (now hardly tenable) that in primitive times left-handed and right-handed people existed in equal numbers, and that more right-handed people survived to leave descendants like themselves because in combats with men or wild beasts, fighters who held the shield in the left hand, thus protecting the heart, were more likely to survive.

Some English Suggestions for Eugenics

At the Institute of Hygiene (London), Dr. Murray Leslie lectured on "The Disabled Soldier; His Future and His Economic Value." He said that the British casualties in the present war up to February 1, numbered 550,000, whereas the total casualties during the whole of the South African War were under 50,000. These numbers would be greatly increased as the war went on, and it was estimated that for every thousand deaths recorded, there would be 200 cases of permanent disablement. The mere fact of a man's being a cripple, or even deformed, would in no wise detract from his potentialities as one of the fathers of the future generation. The present marriage rate was the highest ever known. Those marriages for the most part, had been confined to young, strong, and active soldiers, although there were numerous instances in which our girls had been only too delighted to marry the men of their choice after they had been disfigured or disabled. Women, as a sex, had an aversion for deformities of all sorts, but that would probably not hold good to anything like the same extent if the young couple had met each other before disfigurement took place. From that point of view war engagements, as well as war marriages, were greatly to be recommended. Admiration for our disabled war heroes should be encouraged. It had been proposed to found a League for the marrying of wounded heroes. It was doubtful if such a scheme could be made a practical one, but there was much to be said for the principle. The economic question was the difficulty, yet how many women there were in this country with comfortable incomes who spent large sums on pampered lapdogs.—London correspondence of the *Journal of the American Medical Association*, May 6, 1916.

The

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THE MOST NEGLECTED AMERICAN FRUIT

The papaw, a kind of custard-apple, grows wild in the lower part of the Mississippi Valley, and seems to reach its perfection in Indiana. It is little known even by botanists, and only those who live in the country where it grows are familiar with its value. The American Genetic Association thinks it has much promise of improvement, both by straight selection of the best, and by hydridizing with some of its delicious tropical cousins. A member of the association has made possible an offer of two prizes for information as to where the finest specimens of this fruit can be found; and when they are found, the association hopes to see them put in the hands of a large number of breeders. (Frontispiece.)

WHERE ARE THE BEST PAPAWS?

American Genetic Association Offers $100 for Information about Them—A Native Fruit That Has Been Long Neglected But Contains Much Promise

OF ALL the important native fruits of the United States, the least known is probably the papaw,[1] which grows in the forests from the Gulf of Mexico to the Atlantic, west to Oklahoma and as far north as New York and Michigan. As an ornamental tree or shrub, it is occasionally grown even beyond these limits.

Belonging to the family of Annonaceæ or custard-apples, the papaw has a good deal in common with those delicious fruits. Its creamy pulp is of exquisite texture in the mouth, while its distinctive flavor and its aroma, often too pungent, give it a decided individuality. The shiny black seeds occupy more space than is desirable, in most specimens.

The poor shipping quality of the fruit doubtless accounts largely for the fact that it is so little known outside of the immediate localities where it grows wild. It is not considered eatable until it is dead ripe and has begun to turn blackish in color; it sometimes hangs on the tree until Christmas, although it will have reached maturity in the latter half of September, when the flesh is usually yellow, occasionally white. Good individual fruits, according to Little,[2] usually weigh about half a pound apiece, but sometimes they attain a pound in weight.

Not only is it too soft to ship, under most circumstances, but it does not keep well after it is picked. Sometimes it can be held for a number of days, if picked a little firm, but ordinarily it must be eaten from the tree.

The drawbacks of the fruit, then, are largely of a commercial character. They are drawbacks which can probably be removed by intelligent breeding. With this idea a number of individuals have undertaken during the last few years to improve the papaw; but there is still plenty of room for work, and the American Genetic Association therefore feels the desirability of calling attention to the papaw, and pointing out the attractiveness of the problem it offers.

BEST SEEDLINGS WANTED

Among the wild trees along the creeks and in the underbrush of the river bottoms, there must be many a seedling which combines superior quality with a tougher skin and greater firmness than usual. Probably farmers have picked out some of these trees and transplanted them to the orchard. The American Genetic Association wants to locate these superior trees, in order that they may be made available for rapid propagation; and a member has given $100 as a stimulus to the search for the superior specimens.

Two rewards are offered from this fund. Fifty dollars will be paid for the largest individual tree, and $50 for the tree, regardless of size, which bears the best fruit. The offer will terminate on January 1, 1917, thus including the coming crop-season in which members (or others interested) can keep an eye open for superior specimens.

The award for the largest tree will be made on the basis of photographs. The conditions to be observed are as follows:

Photographs must be on glossy paper, not smaller than 4 x 5 or 3¼ x 5½ inches, and must be of sufficient excellence to allow reproduction in the JOURNAL OF HEREDITY or elsewhere. Photographs in which the tree is so small that its details cannot be made out, cannot be considered. The measurement of the

[1] *Asimina triloba* Dunal. So little is the papaw known that its very name has been stolen from it and applied, through a confusion in sound, to the tropical papaya or tree-melon (*Carica papaya*) which was described by J. E. Higgins in the JOURNAL OF HEREDITY for May, 1916 (vol. vii, pp. 208–220). The genuine papaw is no more related to this tropical papaya than it is to the apple or strawberry, and the application of the name *papaw* to the papaya should be stopped.

[2] A Treatise on the Papaw, by James A. Little, Cartersburg, Ind. Pp. 18, price 25 cents. This is the only thing published on the subject aside from an occasional magazine article.

THE PAPAW TREE IS HIGHLY ORNAMENTAL

It is worth growing around any home, merely for its beauty. Those who know the tree only as it grows in dense thickets can hardly realize what an attractive form it develops when standing by itself and given some care. Its glossy leaves, not unlike those of a magnolia in appearance, attract the eye; even without the added charm of its flowers and fruit, it would be worth a much more conspicuous place in American horticulture than it now holds. The tree can be grown without much difficulty from seed, and is easily grafted. (Fig. 1.)

FLOWER OF THE PAPAW

It is not conspicuous, but possesses an individuality which makes it highly prized. It is purplish in color and has been likened to the flower of a hollyhock, although the resemblance is not very close. It lends itself admirably to ornamental arrangement in the Japanese style which is becoming justly popular in the Occident nowadays. (Fig. 2.)

tree must be given in detail. In making it the only method which may be followed is to take the circumference of the trunk at two feet from the ground. It is desirable that the full height of the tree and spread of branches, as well as the girth, should be stated; if they cannot be measured exactly, they should be estimated. Photographs should, when possible, contain some object, such as a human figure, which will aid in giving a realization of the size of the tree; but such figure should be beside, not in front of the tree. It is necessary that the photograph should include the whole tree. If there are other trees growing beside it and cutting off part of it these other trees should be included in the picture. Contestants may send photographs of as many different trees as they like.

With each photograph, a statement should be submitted telling all that is known about the tree, with reference to its age, the size of crop it bears, the quality of the fruit; the character of the soil and surrounding vegetation. It is particularly necessary that photographers should state whether there are many other papaw trees in the neighborhood—within a radius, say, of five miles. If the tree is on private land, and likely to be destroyed, the fact should be mentioned. It will be helpful if photographers can tell to what extent the tree is subject to attacks by disease or insects. In short, the council desires to gain as much information as possible about the papaw trees of the United States; but it imposes as few hard-and-fast restrictions as possible, because of the varying conditions under which photographs may have to be taken, or under which they have been taken at some time in the past.

The tree should be shown with full summer foliage.

All photographs submitted will become the property of the American Genetic Association, to be kept as a scientific record or used in any way that the council may think desirable.

In the award for excellence of fruit, it will not be necessary to submit a photograph of the tree, since many of the best papaws grow in dense thickets where it would be impossible to make a picture. It will be necessary, however, to give a description of the tree from which the fruit is taken, telling approximately how large it is, exactly where located, and whether or not it can be transplanted, or twigs obtained for grafting. The amount of fruit it bears should also be stated. The contestant must send by parcel post to the office of the American Genetic Association, 511 Eleventh Street N. W., Washington, D. C., at least six fruits, all from the same tree, and all ripe enough to be eaten. The award will be made on the basis of the excellence of flavor, small number and size of seeds, but more particularly on the condition in which the fruits reach this office, taking into consideration the number of days they have been in transit; for the great need of the market is for a fruit that will keep and ship well, and if these qualities are once obtained, selection of the best for propagation can be depended on gradually to improve the quality.

The same tree may, of course, be entered for both awards—for size of tree and for quality of fruit.

CULTIVATED TREES ELIGIBLE

If anyone is cultivating the papaw and has produced a variety that he considers of superior excellence, it will be entirely permissible for him to enter this in competition. The award is not limited to wild trees; although the number of trees in cultivation is believed to be so small that it is probable some of the many wild trees will be found superior to anything known in orchards.

It is the hope of this association that the superior trees found will be propagated by grafting, and a large quantity of them secured within a few years. The papaw can be grown from seed, but only with difficulty from suckers, while transplanting is recognized to offer much trouble. One correspondent describes the general experience when he says, "I have been growing papaws for seventy-five years, not willingly but because I could not help it. It is claimed there is no way to kill a papaw except to transplant it and try to make it grow."

Grafting in the spring has been found to offer no great obstacles, however, and is the best means of propagation, from the plant-breeder's point of view. Budding has not given good results, but this may be due to wrong technique. So far as is recorded, the papaw has not been grafted on any stock except its own, and there appears to be no necessity for any other stock.

One of the promising fields for plant-breeding, in connection with the papaw, appears to be in hybridizing it with its close relatives, the tropical annonas, the genus which includes the bullock's-heart, sweet-sop, sour-sop, and the

incomparable custard-apple or cherimoya. These fruits are larger and finer than the papaw, but too tender to grow in the United States except in southern California and southern Florida. There would appear to be a good chance that they could be crossed with the papaw, and a fruit produced which would be hardy in a large part of the United States, while superior in quality to the papaw itself. So far as is recorded, this cross has never been made.

THE PAPAW

Cross section of a fruit, natural size, photographed by W. E. Rumsey, of the West Virginia Experiment Station. The flesh is ordinarily yellow but sometimes white, and custard-like in consistency, with a peculiar pungent aroma. (Fig. 3.)

PROPAGATION FROM SEED

It may be helpful to give the advice of the late James A. Little on the propagation of the papaw. To grow seedlings, he writes, "My plan, which has been entirely successful, is to make a hill like a watermelon hill and plant about five seeds two or three inches deep in the fall. In part for protection but mainly for shading the plants when they come up I place a barrel with both heads out over the hill and let it remain for a year or two. After that the barrel may be removed and then the plants will bear the sun. It must not be expected that the plants will come up until the harvest or later. The plants will not get more than 2 or 3 inches high the first year, but the root will be proportionately much larger than the top. The second year the plants will grow 6 or 8 inches high and after that they will greatly increase in growth from year to year. It will take them six or eight years to come into bearing."

More recent experiments than those of Mr. Little indicate that if planted as soon as taken from the fruits the seeds lie dormant in the soil for one year and germinate the second spring. There appears to be little difficulty in transplanting the young seedlings from the seed bed to the nursery row and getting plants 12 to 18 inches tall in two years, providing they are grown in rich garden earth. Transplanting has to be done in the spring before any growth starts.

Finally, as the season of ripening is coming on, it will be of interest to quote Mr. Little on the value of the fruit.

"The principal use of the papaw," he writes, "is to eat from the hand but there are other uses that it can be put to. It makes splendid custard pie. There is no finer dessert than papaw eaten with cream and sugar. It is used to make beer the same as the persimmon by putting the fruit in a jar, mashing it, and putting water on it and letting it stand until fermented. It also answers to make pudding just the same as persimmon pudding is made. It is also said that brandy equal to peach brandy is made of papaws. Marmalade which is equal to that of pears or peaches may be made of papaw. The custard may be spread on a board and dried like

pumpkin leather. Papaws may be kept in their natural state till midwinter or longer by laying them down in oats. At this present date, January 27, Mr. Thompson has them down in oats that are just as good as when taken from the tree." On this last point, another correspondent writes that he has found no better place to store them than in the dry leaves at the base of the tree.

Eugenics for Arabic-Speaking Peoples

Hall al-'Uqdah bi-Mulakhkhas al-Ifâdah fî Intâj al-Awlâd hasab al-Irâdah (The Untying of the Knot in a Comprehensive Resumé on the Production of Children according to Will), by A. J. Arbeely, M.D. Pp. 193, price, $2.50. Published by the author, 1723 U Street N.W., Washington, D. C.

The title of this book, implying that it is devoted to sex-control, fails adequately to describe its nature, for the theory of sex-control (based on nutrition and the influence of the parental mind) occupies only a third of the book, although it is said to be based on 1,000 cases. In the first two-thirds of the book the author, a Syrian physician with forty years of experience, gives a general treatise on eugenics, marriage and parenthood. It is written in a wholesome tone, with abundant detail, and gives an amount of information about heredity and race betterment which has not hitherto been available in the Arabic language, although the ancient Arabs had some sound empirical ideas on the subject. Muhammad is reported to have commanded, "Select your wives with a view to offspring," and again to have said, "Avoid the rank plant which grows on a dung-hill." When asked to explain this he replied, "I had in mind the woman who is beautiful but whose ancestry is bad." Marriage and parenthood were held in the highest esteem, but the veneration of them was sometimes carried to an extreme, as is reflected in another saying credited to the prophet, "A fecund black wife is preferable to a sterile white one." Dr. Arbeely does not attempt to discuss this phase of the subject, which offers an attractive field of research for some Orientalist. It should be added that the literary style of the author is admirable, as those who know his lexicographic and journalistic work would expect.

Feeblemindedness and Charity

More than half of the men who, in New York, apply to the Joint Application Bureau for Aid or patronize the Municipal Lodging House are morons, according to the estimate of Charles B. Barnes, Director Bureau of Employment of the State of New York. If careful examination should prove his estimate to be correct, he says, "it would mean an entire change in the attitude of the courts, charitable organizations, and the public generally toward them. We would no longer seek to 'rehabilitate' them. The long and weary path of attempting to make them self-supporting would be abandoned. The attempt to 'reform' them, in the sense in which it is now used, or the obtaining from them of promises to reform, would not be made. Other disposition would have to be made of them. We would commence to treat our mentally defective as well and with as much consideration as we now treat our physically defective, and no more stigma would be attached to the one than to the other." For treating the feebleminded among the applicants for charity, he declares that the farm colony with forcible detention is the only practical plan; by this means most of them could be made self-supporting, while at the present time most of them are annually costing society far more than they earn. On economic as well as humanitarian grounds, therefore, a revision of methods of distributing charity, which would eliminate the feebleminded, appears to be justified.

MUSICAL ABILITY

Bases of it Inherited by Nearly Everyone—Difference in Ability Due More to Training Than to Heredity—Means for Bringing Latent Ability Into Expression

Mrs. Evelyn Fletcher Copp, *Brookline, Mass.*

IT IS generally supposed that musicians are born, not made. A modern student of heredity, for example, writes of musical ability:

"This quality is one that develops so early in the most marked cases that its innateness cannot be questioned. A Bach, matured at 22; a Beethoven, publishing his compositions at 13 and a Mendelssohn at 15; a Mozart, composing at 5 years, are the product of a peculiar protoplasm of whose tenacious qualities we get some notion when we learn that the Bach family comprised twenty *eminent* musicians and two-score others less eminent."

Following out this line of attack, let us look a little further for evidence that musical ability is innate. Of the Bach family I shall not speak, for its history is well-known: it presents an amount of musical genius unrivaled in history. But if we examine the ancestry of other great musicians, including some of those mentioned by the writer just quoted, we find little to indicate that their preeminent musical ability was due to any extraordinary combination of heredity.

Among such cases is Haydn. His father was a wheelwright, his mother had been a cook and, although both were fond of music, neither could be reckoned a musician as we diagnose the term. Schubert is another example; and the immortal Robert Schumann had no ancestors who were even slightly addicted to music. Even the musicians who can point to a musical parent or grandparent have, in many striking instances, seemingly failed to transmit to their offspring even a trace of their stupendous ability. Another interesting point which strikes even the casual observer of the musicians of the past is that musical heredity seems to be anti-suffrage. When heredity might seem to have caused musical ability in the sons, the daughters seem usually not to have been extraordinarily benefited; and in this connection it is also of interest to note that, while many women have excelled as vocal or instrumental performers, the originality necessary to musical composition has been conspicuously lacking and there are no women who come even within hailing distance of Beethoven, Mozart, Handel and a dozen other men we might name.

A COMMON INHERITANCE

Now, I do not propose to argue from these facts that musical ability is not a matter of heredity. I think it is a matter of heredity, but that *almost everyone possesses the heredity.* Twenty years of teaching give me reason to believe that, although great genius will doubtless continue to be sporadic and unaccountable, real musical ability is much more common than has been supposed. Genius, like murder, will out. It cannot be suppressed by environmental obstacles, but talent, often overlooked, may be discovered and brought to great perfection. It seems, indeed, that music, like poetry, may be a primal talent; that, as all children are born poets, they may also be born musicians and also, very similarly, that as 99% of humanity lose all poetic faculty during the years of early childhood because of the artificial conditions of modern child life, so the very large majority of children lose their native musical ability through lack of training of the ear and mind during their most susceptible period. Education should come to the help of heredity to reclaim and develop man's natural gift.

We are all born with ears and they are formed for hearing as the eye is for seeing; they are, moreover, capable of hearing far more and better than they

ACQUIRING A SUPPOSEDLY INBORN GIFT

Positive Pitch—the ability to name a musical note when it is sounded—has often been considered a rare, inborn trait which marked its possessor as particularly fortunate in the inheritance of musical ability. Recent evidence, however, indicates that it is by no means a sharply inherited character, but a function of the mind which can be acquired by almost anyone, with proper training. The children here photographed are acquiring Positive Pitch in an interesting way: one of them sounds notes on the piano, the two blindfolded ones name the notes, and the boy at the table then locates them on the staff, by means of wooden symbols. (Fig. 4.)

are accustomed to doing. We carry them around with us everywhere, but we really pay very little attention to them. We let our children speak in a slip-shod, indistinct way and we listen carelessly. We leave good talking and singing to the professional musicians and orators, which is just as unreasonable as to leave good seeing to the professional artist and poet. We are only just beginning to learn what the normal ear is capable of, for instance in the matter of Positive Pitch, that is, ability to recognize and name musical tones. The lay public has been accustomed to consider Positive Pitch as a gift wrapped in the exclusive tissue of genius and doled out to the ultra musical only. One who can enter a room where a musician is singing or playing and say, "He is singing high C, or baritone B," has hitherto been looked upon as a prodigy. This is by no means necessarily true. By proper training this power may be acquired, speaking very conservatively, by 80% of normal children. Children who have been thought to be entirely lacking in musical ability, some of them apparently tone deaf, after a few months of training are able to sing "Center C" on demand and to recognize it when it is played or sung and they soon become equally familiar with the other musical tones.

HUNDREDS OF CASES STUDIED

I base this statement on the experience of having taught some hundreds of children; the corroborative experience of the teachers I have trained would add hundreds more cases. Certainly I do not say that every one can acquire, by training, this once mysterious gift of Positive Pitch, but I know that most people can do so, if they begin at an early age.

This surely indicates that musical talent is much more widespread than has been thought and that the cases we have quoted of the appearance of wonderful ability in the children of seemingly non-musical parents, may be merely instances of the inheritance of latent characters.

Some children will, of course, not acquire Positive Pitch as quickly as others. There are children who do not so easily learn to write English from dictation as others; but do we therefore allow them to give up and say that they cannot be taught? By the time he is ten or twelve any normal child can learn to write correctly from dictation five hundred words or more. Now, taking every white and black key on the piano there are only eighty-eight. Given a fair chance and a mind unmesmerized by the idea that reading music and Positive Pitch are difficult and require special gift, a child may as easily see mentally the sign for any sound as he sees the words that he hears you dictate to him in English.

That the results of music study have hitherto been so meagre is due to parental indifference and the faultiness of the methods of teaching music. Teachers have insisted that the child should not be allowed to play the piano by ear, claiming that this will ruin his musical ear and make reading by sight impossible! Fancy a mother fearing that if her child speaks English first by ear, he will never learn to read it! As music is primarily an art making its first and greatest appeal through the ear, it is unreasonable to suppress the interest and initiative which naturally appear first through the ear and then, later on, by laborious ear training lessons to try to get back the interest and power which we have ignored during the most formative period of the child's life.

MUSIC EASILY ACQUIRED

The acquirement of musical education is or should be comparatively easy, not only because of the smallness of the musical vocabulary (consisting as we have said of only eighty-eight tones), but also because of the universality of its notation. The present system of musical notation, though perhaps not perfect, has this great advantage, that it is the same all over the civilized world, so that when one learns it in America, the musical thoughts of France, Spain, Germany, Italy or Russia are equally accessible. A child

LEARNING THE TIME-DIVISIONS OF MUSIC

A sense of ryhthm has long been considered innate, but recently psychologists have brought forward some evidence to indicate that it may be merely the result of early training. Whether this be true or not, it is certain that many persons have a defective feeling for and knowledge of the time-divisions of modern music. Children are now being taught the value of half-notes, quarter-notes, rests, etc., by means of blocks of various lengths, and the mental conception of these things becomes so clear and simple that they are allowed to give physical expression to what they have so easily understood, by marching, clapping and acting the musical passage. (Fig. 5.)

A LESSON IN MODULATION

As against the view of extreme eugenicists, that musical ability is an inherited trait, which you either do or do not get from your parents, many psychologists claim that music is a universal, natural method of self-expression, and that every normal individual possesses the ability to develop it just as he possesses the ability to develop the power of expressing himself in English, or whatever his mother tongue may be. The numerous individuals who are considered or consider themselves "absolutely unmusical" are held to be the results of lack of education, or wrong methods of education, in this form of expression. Mrs. Fletcher-Copp has found that children, if allowed to develop their ability in a natural way, can soon reach achievements that many adults of long training cannot surpass. This photograph shows one of her means of teaching children modulation. By this simple piece of apparatus, on which different chords can be represented by movable pegs, no less than fifteen different simple ways of modulating can be easily taught to any child. With such a stock of experience, he will know more than the average teacher. Of 700 music teachers, Mrs. Fletcher-Copp says she found only three who could modulate easily and happily, and they did not pretend to understand what they were doing. (Fig. 6.)

learns to read English easily and well during the first six years of his school life (that is from the age of six to twelve); he might just as easily learn during the same time to read fearlessly and well the universal language of Music.

If you were to visit a public school and express surprise that the wash-woman's daughter reads as well as the child of your own cultured neighbor, you would be told that "thanks to the System," the advantages of birth are being wonderfully counterbalanced; that, though the effects of a few generations of culture may tell in other ways, no one is dependent upon his

forefathers for ability to read, spell or write. Scientific teaching makes these things possible to all mankind.

Exactly as normal is the ability to learn to read and think music.

The first conclusion, then, which I venture to lay before students of heredity, is that they have, with the material at present available, no proper ground for drawing conclusions as to the distribution of musical talent in the population; because there is a great deal which is merely latent, having been denied the possibility of expression. The inheritance of a trait and the expression of a trait are two different things. No student of heredity would consciously ignore the distinction, but in the study of the inheritance of musical ability they have unconsciously ignored it, and therefore their results do not correspond with the reality.

Time and again, as I have said, I have taken children from families where there was apparently no musical ability, and where the child himself was supposed to be utterly deficient in music. The student of heredity, I fear, would unhesitatingly have set down such a child as non-musical because of failure to inherit the prerequisites. Yet this child, after being educated in a natural manner, has acquired Positive Pitch, has learned to compose, to express his own feelings musically, and to analyze compositions which would baffle many teachers.

Thus, although a child may come from a supposedly unmusical family, it by no means follows that the child cannot develop musical ability of a high order. On the other hand, what of the cases where the child of two musical parents fails to show talent?

I have in mind one striking case of this sort which I met years ago. The father was a pianist of international renown, the mother a gifted musician. They hoped, of course, that their child, with its double inheritance, would surpass either one of them: they confidently expected such a result. The child was set to studying music at an early age, but made no progress whatever; he was declared to be dull, uninterested, hopeless.

I was naturally curious to find the reason for this state of affairs: and they were not hard to find. Almost the first inquiry I made disclosed the fact that the child showed a dislike for tedious hours of practicing, and was therefore frequently shut up in a dark closet for an hour or two at a time, to instil in him a greater love for his lessons, and a spirit more obedient to the wishes of his parents. Small wonder that he lost interest in music; and without interest, without an eagerness to learn, little can be done. But where the interest and will exist, it is an unusually defective child that cannot acquire a considerable amount of musical ability; and the same to a less extent holds good of adults.[1] Perhaps it may be of interest if I explain in a little detail the views on this point to which twenty years of teaching have brought me.

If the motive for studying music be made clear and the method of teaching be sound, we may count confidently on the results. Browning says, "It is better Youth should strive, through acts uncouth, towards making, than

[1] This view has been developed of late years by a number of psychologists. In the Archiv für die gesamte Psychologie, XXXIV, 12, pp. 235–253 (Leipzig, 1915), Siegfried Bernfeld of Vienna cites two university students whom he studied, each of whom was supposed to be utterly unmusical, until the exertion of the will, as he says, led to the development of considerable enjoyment of music. He concludes: "The individual's reaction to music is by no means wholly decided by the nature and quantity of his psychophysical tendencies. It is influenced to a certain degree by the will to be or not to be musical . . . Even when accurate tests have shown that a person possesses all the elements of musical ability, it cannot be foretold with certainty whether he can acquire musical appreciation, for it is possible that an inhibition with retroactive force against music may exist in him, a will to be unmusical, or at least to seem so to himself and others." Cf. also Sterne, die differentielle Psychologie (1911), p. 265. For the opposite view, that heredity is the primary factor, consult Hans Rupp, Ueber die Prüfung musikalischen Fähigkeiten; Ztschft. f. die angewandte Psychol., IX, Nos. 1 and 2; also C. B. Davenport, Heredity in Relation to Eugenics (New York, 1911), p. 48. The psychological literature on music is large; for an interesting account of how musical ability is measured see Carl Emil Seashore, Psychology in Daily Life (New York, 1913), pp. 196 ff.—The Editor.

COMPOSITION OF A 13-YEAR-OLD BOY

Acting on the principle that music is as natural a form of self-expression as are words, Mrs. Fletcher-Copp tries to get children to express their feelings in this way. The above composition represents the thought of a 13-year old boy after studying a picture called "The Last Outpost," in which an Indian who has been driven from the ancestral hunting-ground of his tribe contemplates the waters of the Pacific with the thought that if he is again forced by the white man to move, it can only be into the ocean. (Fig. 7.)

repose on aught found made." We have made the mistake in music teaching in the past of putting the finished product of another's mind before our children and forcing them to copy it. Behind this mistake is the wrong motive. The main idea was to force the child to copy, parrot-like, at the earliest possible moment, the thoughts of some one else. Music was looked upon merely as a means of adornment, as something to be plastered on the outside to add to the attractiveness of the child. The motive is altogether wrong. Not slavery to someone else's ideas but freedom to express one's own ideas should be the aim. Watch a tiny child seated on his mother's knee. She has been playing and he has been told to keep his little paddies on her wrists, but presently he pushes her hands aside and substitutes for the beautiful composition his own incoherent pattings and poundings of the keys, striving "through sounds uncouth" to express himself; but, alas! he is stopped. It is as though a two-year-old should toddle to his mother and stammer with his crooked little tongue, "See, mama, ve sun is playing hide and go seek wif me," and the mother should say, "You must not talk that way, my child. You should say, as Homer writes, 'Lo! Dawn the rosy-fingered, opes wide the gates of Day.'" What would be the effect of this classical method of teaching English upon one's joy and proficiency in acquiring the mother tongue?

METHODS OF EDUCATION

The motive, then, for learning musical notation must be for the purpose of freeing the child by giving him the means of expressing his own ideas on paper as well as giving him pleasure in reading easily and joyfully the thoughts of others. The means used for the attainment of these ends are most important. They must cultivate as many of the child's senses as possible. If he can feel the symbols as well as see them; if he may see them in a big, tangible form; then through this touch contact and through this ready sight, it

occurs to him to place the symbols thus and so and then to find out on the piano what the symbols so placed by himself will express when sounded.

We, therefore, give the child notes of heroic size to play with and a loose-noted key board to take to pieces and become familiar with by putting together again. We have further invented games which call into play qualities of mind the lack of which has wrecked many a musician in the past; games which cultivate the ability to think calmly, coherently and quickly before others, games which require rapidity of thought and action and which develop unselfishness, generosity and balance, mental, emotional and technical. It was not music which made for the lack of these qualities as has often been insinuated; it was a lack of the most valuable traits of a true musician, missed by acquiring a certain musical veneer without real, scientific, educational growth.

In the past to be a musician was almost a synonym for being characterized by nervousness, lack of balance, general peculiarity and uselessness in practical life; but, to repeat, these deficiencies were not because of music but rather proved a lack of musical development in its entirety.

If we will consider music as a language, not so much of the intellect, as of that finer, higher, more spiritual part of us, a language which this soul of ours needs; and if we will then consider all the sensible things we do to acquire other languages and try these same things for the attainment of the musical language, we may make some interesting discoveries. When a 5-year-old child speaks English it is because he has thought it and has his own thoughts to express. First in music, then, a child should be led to think his own music, to speak his own music before he is taught to copy. He cannot become an independent thinker by first being wholely and solely a copyist. Improvising and modulation in music are equivalent in English to power to express the sense contained in a prose paragraph or in a verse. It is like taking six adjectives, three nouns, two verbs, and three prepositions and making a sentence out of them. These rudimentary exercises in English lead to more or less freedom in the art of expression of ideas if we have any to express later on. We do not say at the outset that there is no earthly use in having the child participate in such and such exercises because he will never be an author; the being an author is submerged in the practical usefulness of self-expression. Precisely the same attitude should be taken in regard to music if it is to be allowed to do the good and be the good to us that it may be. When we take an idea from a poem or an essay and express it in our own words, we are improvising in English. Are we never to do this in music? Can we get nothing except the literal thought word for word as we read it?

THE VALUE OF MUSIC

The value of learning music is not in the number of pieces one may play, but in the musical thoughts one can think. Real music is self-expression and, far from making the child self-centered, it should make him most sympathetic of the efforts of others. A child who has made his own Reverie or dream has the keenest appreciation of a "real composer." We know that to trim a hat does not cause one to be unappreciative, but the reverse, of a well-trimmed hat. So it is with cake-making, dress-making, story-making, poem- and music-making. We do not complain because so few of the boys and girls, who during their school days wrote essays on "The Dog," "Our Country's Flag" or "A Visit to Grandmother," fail to become authors or authoresses. We are satisfied if they are able to express themselves well in spoken or written language as required by the demands of every-day life. But there are times when every human being feels the need of a language beyond the power of words. Plato said, "Music is to the mind what air is to the body." Now air is a necessity but we moderns have not believed music to be a necessity. We have considered it merely an accomplishment. How much more it might be! Just the other day a boy of 13 brought to me the little composition which is reproduced in Fig. 7. He had

seen the picture weeks before of a lonely Indian standing against the sunset sky, gazing in calm desperation into the ocean at his feet. This would be the next move if he were ordered further west. The picture was called "The Last Outpost" and it stirred up feelings in the boy's heart which presently got out on paper (much the safest, healthiest place for them) in the form of this little composition. This is only one example of oh, so many natural outbursts of feeling in music.

Every human being feels at some time or other the need of music, but this music which he needs is not the artificial substitute which has usurped the place of the real thing. Music can be to each only what he is capable of hearing, feeling and understanding. Therefore when one sits at the piano and plays a Beethoven Sonata which one cannot think, cannot analyze, cannot mentally hear—plays exactly in the manner of the Herr Professor—one is exemplifying the parrot in music and this is an unsatisfactory accepting of the unreal for the real, which gets us nowhere. Man is not the sum total of his words but of his thoughts and it behooves us to stop copying words, words, words in music and to begin to think and to express ourselves.

When we really believe what we say, that "nothing is too good for the American child," we shall give him eight years' training in the public school in self-expression in music and the results will prove beyond cavil the source and cause and meaning of music. They will also, I am sure, leave no ground for the belief now entertained by some geneticists, that musical ability is a rare "unit character" due, as has been alleged, to some "defect in the protoplasm" which only a few families possess; they will show on a large scale what my own experience has already made clear to me, that musical ability is part of the universal inheritance of man, just as the ability to talk is, and that the differences between individuals in respect to it are due much more to training than to differences in the heredity.

Official Register of Selected Plants in Hungary

The Hungarian Minister of Agriculture has accepted the scheme proposed by Emile Grabner in his report presented in 1913 to the Royal Institute of Plant Breeding ot Magyarovár and has issued an order regarding an official register of selected plants in Hungary. On the basis of this regulation, the State recognition and official registration of selected Hungarian plants came into force, on September 1, 1915. The Royal Institute of Plant Breeding is responsible for the keeping of the official register. The effect of this provision will be to give an additional impetus to plant breeding which of latter years has already made such rapid strides in Hungary. On the one hand it will protect Hungarian growers from the adulteration of seeds and the false description of inferior seeds, and on the other hand, it will afford a safe guarantee to the purchasers of the strict selection of the species the seed of which they wish to acquire.

At the same time, the Minister of Agriculture has authorized the said Institute to present, as soon as possible, detailed schemes regarding the development, on a large scale, of the intensive selection of Hungarian plants. The Minister considers it desirable that the work of selection should not be left merely to a few enthusiasts but should be taken up in a methodical manner by all practical agriculturists, with the close collaboration of the said Institute.—*Bulletin of International Institute of Agriculture, Rome.*

Crossing Apricots and Peaches with Cherries

The wild Compass cherry has been crossed with the apricot and the peach, at the Minnesota state fruit-breeding farm. A number of seedlings have been secured but have not yet fruited. The cherry was used as the mother parent, and the hybrids resemble the pollen-bearing parent strongly in every instance, according to Supt. Charles Haralson.

A BOTANICAL PARADOX

D. F. Higgins, *Pekin, China*

CHINA is supposed to be the home of many strange things, among which those of the vegetable kingdom are not the least. There are giant persimmons, to four inches in diameter, and better to eat than Americans can imagine, for all the "pucker" is gone before they are ripe; and there are full-grown pine trees not over two feet high. Lilliputian lemon trees grow in one's parlor and bear fruit ready to be picked for the fish when it is served in the dining-room The Chinese farmer is a pastmaster, in an empirical way, of the arts of budding and grafting. The "English" walnut is indigenous to China.

One day I made a visit to the Great Bell Temple, a few miles northwest of the city of Peking, and there I found a botanical wonder which outdid all that I have ever seen or heard about. In grafting, it is generally thought that the species must not be far removed from each other; but here I found a specific gap of a botanical phylum, and an evolutionary gap of geologic periods of time, covered, I was assured, not by human means, but by nature's accidents.

In the court of this temple is a pine tree (*Pinus sinensis*) from the side of the trunk of which, at about 8 feet above the ground, is growing a healthy elm tree (*Ulmus pumila*) about 1 foot in diameter. The junction is shown in detail in the accompanying photograph. Around the junction there is no sign of any break in the bark of the pine tree.

Here is a problem for plant chemists. Can the food solutions of the gymnosperms be utilized by an angiosperm? and I would ask the students of genetics: Can the "sport" form of variation, so often credited with the origin of new species, extend to such a violent disruption of nature's continuity as this? Or, did one elm seed, of the millions which have doubtless lodged in the crevices of pine tree bark, so sprout and take root that, through inherited or environmental advantages, it was able to assimilate the nutritive substances of the pine? Or has Chinese arboriculture surpassed itself, and performed this union which almost staggers reason?

This is truly a very wonderful thing, but this is not all. In the crotch of the pine, some 18 feet above the ground is still another deciduous angiosperm growing from the same pine tree! This tree is a paper-mulberry (*Broussonetia papyrifera*.) At the time of these observations, in the spring of 1915, it was about 2 inches in diameter, and growing lustily. The fruits, somewhat like sycamore balls, were about half grown.

It would be interesting to know if definitely recorded instances of such growths as these are to be found elsewhere. (Note—Unless there is definite evidence to the contrary, it would be much easier to believe that the pine tree is partly hollow, and that the elm and paper-mulberry have sent their roots down into earth and decaying matter in the hollow trunk.—The Editor.)

The A. G. A. and the A. A. A. S.

The American Genetic Association, being affiliated with the American Association for the Advancement of Science, is entitled to have two representatives on the council of the latter organization. Prof. Albert F. Blakeslee of the Carnegie Institution, Cold Spring Harbor, Long Island, N. Y., and Prof. Edward N. Wentworth of the Kansas State Agricultural College have been appointed to act in this capacity. The next meeting of the American Genetic Association will be held in New York City, December 26–30, in connection with the meeting of the A. A. A. S.

THE STRANGE GUESTS OF A PINE TREE

In the court of the Great Bell Temple, a few miles from Pekin, stands this Chinese pine from which are growing two deciduous trees which are about as little related to the pine as any trees could be. One, to which the man is pointing, is an elm; the other not plainly visible in this photograph, but to be seen more clearly in Fig. 9, is a paper-mulberry. The Chinese are pastmasters in horticulture, but it is impossible to believe that they could graft such diverse species as these. The botanist might have abundant faith to believe that the lion and lamb will lie down together, but, unless he had seen it, he would probably be unable to believe the story which this picture tells. Photograph by D. F. Higgins. (Fig. 8.)

AN INCOMPATIBLE HOUSEHOLD

Near view of an elm growing from the trunk of a pine. In the crotch of the pine, above the elm, may be seen the small black trunk of still another tree—a paper-mulberry, the foliage of which occupies much of the upper right-hand part of the photograph. The elm and paper-mulberry are so different from the pine that it is hardly believable that they could live on its sap, but it may be that the trunk of the pine is partly hollow and contains earth and decaying matter which furnish nourishment for the strangers lodging on it. Photograph by D. F. Higgins. (Fig. 9.)

LET'S POSITIVIZE OUR NEGATIVE EUGENICS

A. E. Hamilton, *New York, N. Y.*

IF WE are going to get the moral support of the people for programs of segregating and colonizing our hereditary defectives in a really large way, we will have to present a program that is alive with the spirit of "something to do." Merely caging people who are a nuisance doesn't arouse much genuine human interest, or at best this interest is academic. But tell a man that you can take a lot of human damaged goods and make it into a useful constructive factor in our national life, and he will sit up and listen.

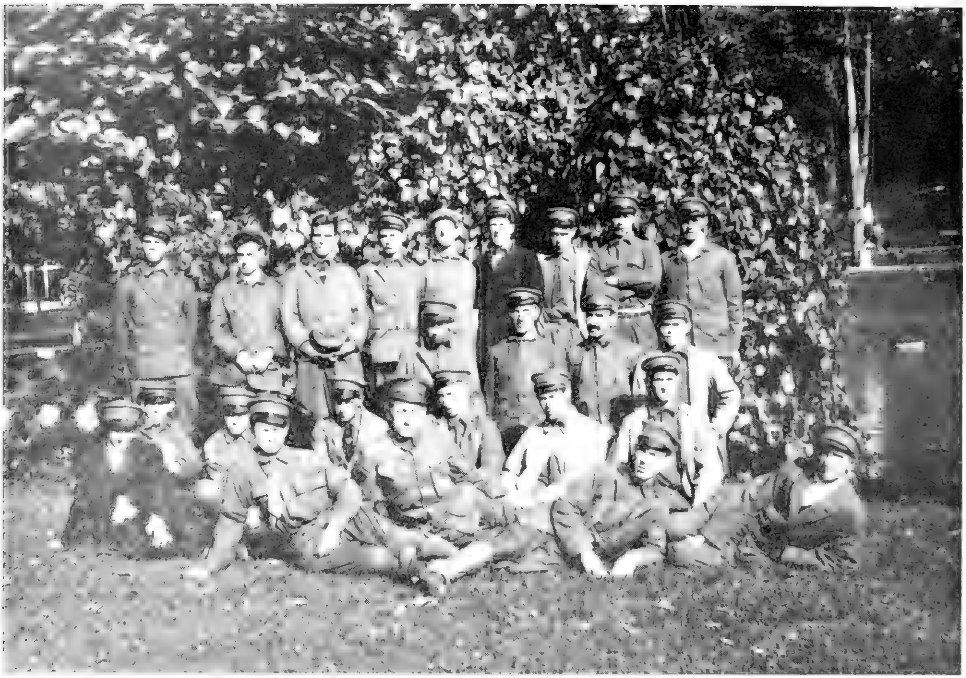
Charles Bernstein, Superintendent of the Rome State Custodial Asylum, at Rome, New York, has given negative eugenics a golden text that shines.

He turned twenty-five of his higher grade inmate boys into Boy Scouts (all of them passed the tenderfoot requirements), uniformed them and sent them up into the Adirondacks for a month of summer camping last October. He asked Governor Whitman if these boys couldn't be used in reforesting work. They had plenty of time, they loved to work out-of-doors, they were well superintended by George Kuehn, a nature-loving Scout Master who could get that gang of state wards to do anything within reach of their possibilities, and do it happily and well. Governor Whitman was willing, but some small-minded political parasites found a technical objection to State employment of such labor and threw sand in the bearings of the enterprise. But Bernstein persisted.

The boys were sent up to camp, and incidentally a carload of seedling spruce

THIS BARE HILL WILL BECOME A FOREST

And the change will be due to a bunch of boys who now represent only waste human material, in most places. The feebleminded are not able to compete on equal terms with the normal, in the struggle of the world's work, but they are abundantly able to do many kinds of work, and do it well, if they have proper direction. They might be made an asset of the State, instead of the liability they are at present, if more people had a sympathetic understanding of their possibilities. (Fig. 10.)



DO THESE BOYS LOOK DANGEROUS?

Popular ignorance tends to confuse the feebleminded with the insane and imagine that they should be caged in the interests of public safety. As a fact, most of them are strong, healthy individuals who are, mentally, merely good-natured, irresponsible children. They require careful supervision, but given that they may live not only happy but productive lives. The campaign for "negative eugenics" should be devoted to putting the defectives not only where they can do no harm but even more to putting them where they can do good. The conservation team here shown is made up from boys at the Rome State Custodial Asylum, N. Y. (Fig. 11.)

was left on a siding of the railroad nearby. The door of this car was open, and boys will be boys. Two by two they carried off the young trees, and planted them over a space of some one hundred and fifty acres. They did the work admirably, so well indeed that the State Commissioner of Conservation commended it warmly, and said it ranked as high as any work done by regular paid labor. Just one hundred and fifty thousand trees were set out, all in a spirit of fun and play. The keep of these boys as state wards, plus the cost of transportation, amounted to $400. The net value to the State of the work they did was $1,000 and in twenty years time there will be a broad green monument to the boys' memory.

There are hundreds of thousands of acres of national land that need re-foresting and conservation work. There are several hundred thousand unfortunate young men and boys who cannot compete favorably with their fellows in the world who could do this work if they were rightly directed. Camp colonies in summer, transportation southward in cold weather for work down there, institutional housing in winter where necessary—all these things are coming, and they will come all the more quickly as people are told such stories as this, and stories such as Alexander Johnson, of Vineland, can tell by the ream of the possibilities that lie in subnormal nervous systems.

Eugenics will make progress just about in proportion as it eliminates its emphasis on pathology and concentrates on the positive aspects of human possibility.

HYBRID TREES

Many Natural Hybrids, as Well as Sports, to Be Found—Artificial Hybridization Leads to Production of Trees Valuable for Their Great Vigor—What Has Been Done and What May Be Done

A Review by W. H. Lamb

United States Forest Service, Washington, D. C.

BREEDING short-lived plants and orchard trees is now a well-established art, but breeding timber trees has hardly been undertaken. The importance of such work is being recognized, however, and Prof. Augustine Henry has made a notable contribution in his study of natural and artificial hybrids.[1] His recent paper on the black poplars[2] offers some excellent examples of the occurrence of natural hybrids and the value of artificial ones.

The cultivated species of Populus which have been found desirable for commercial plantings, he points out, are without exception of "unnatural" origin, in that they are either sports or hybrids, and not ordinary species.

"A sport is usually a solitary phenomenon, arising either as a sporadic peculiar seedling from a seed, or developing out of a bud on a tree as a single branch with some peculiarity of twig or leaf. A sport may be looked upon as a freak, not forming the starting-point of a new species, but speedily becoming extinct if left to nature. Sports, when of interest on account of the curiosity or the beauty of their appearance, are propagated usually by grafts, cuttings, or layers; being only in rare cases perpetuated by seed. Some sports are due to arrested development. The tree, in the course of its life, often passes through stages, like those of an insect. The seedling of many species differs from the adult tree as a larva from a butterfly. The infant ash has simple leaves. The sport known as the simple-leaf ash is simply a seedling ash, which has never progressed to maturity and may be called a persistent larval form. The Irish yew was found in 1767 as a seedling on the mountain behind Florence Court in Fermanagh, and is characterised by all the branches being directed vertically upwards and all the leaves spreading radially around the twig. This is apparently also the seedling stage preserved. All the myriads of Irish yews, now scattered throughout the world, are cuttings either from the original tree at Florence Court or from trees that were derived from those cuttings.

THE LOMBARDY POPLAR

"This upright, so-called fastigiate form may occur as a sport in any species, the best known being the Lombardy poplar, which originated on the banks of the Po about 1700 and subsequently spread over the world. The Lombardy poplar and Irish yew are striking examples of the immense number of individual trees of a sport that may exist, this abundance being entirely due to human agency. Left to nature, these two remarkable forms would never have multiplied, and would have ceased to exist, once the original trees had succumbed to old age or injury. The fastigiate sport is of rare occurrence in most genera, usually only a single original tree being recorded. Amongst, however, the cypress and juniper families, fastigiate seedlings are

[1] Henry, Augustine, "The Artificial Production of Vigorous Trees," *Jour. of Dept. of Agric. and Tech. Instr. for Ireland*, XV, 1, 1915. Reviewed by W. H. Lamb in *Proc. Soc. Am. Foresters*, X, 2, April, 1915.

[2] Henry, Augustine, "The Black Poplars." *Trans. Royal Scot. Arboricult. Soc.*, pp. 14–27, January, 1916; also in *Gard. Chron.* (London), LVI, pp. 1, 46, 66, July, 1914.

A NATURAL HICKORY HYBRID

This tree, which is believed to be a cross between the pecan (*Hicoria pecan*) and the shellbark hickory (*H. laciniosa*) is standing in a rich river bottom 12 miles from Mt. Vernon, Ind. Like most first-generation hybrids, it is a vigorous and rapid grower, but perhaps for this very reason its leaves and branches are tender and succulent—at any rate it seems to attract all the insect pests in the neighborhood. This is not always the case with hybrid trees, however, for many of them are superior to their parents. The immense size of the nuts which this hybrid bears can be judged from one which the man at the right of the picture holds in his hand; in Fig. 15 a single one of them is shown natural size. Photograph from the United States Department of Agriculture. (Fig. 12.)

common; and the upright habit appears to come true from seed. The Mediterranean cypress has been known in this peculiar narrow form for centuries, but always cultivated. In the wild state, as in the mountains of Cyprus, the tree is widespreading in habit. The common juniper, however, is often fastigiate in the wild forests of Scandinavia. This exemplifies the difficulty of strict definition in nature, as the fastigiate habit, which is a rare sport in most trees, becomes in the junipers and cypresses almost a normal form, capable of being perpetuated by seed."

If sports among forest trees are more common than has been generally supposed, the same is true of hybrids. Prof. Henry mentions the hollies of Great Britain, which include numerous hybrids and sports, as well as good species. American naturalists are familiar with the hawthorns, whose hybridity has lately been demonstrated by Prof. E. C. Jeffrey of Harvard and his pupils.[3] The extraordinary state of affairs in the hawthorn genus (Crataegus) may best be realized if we recall that more than 700 alleged species of Crataegus have been described, whereas, of all other trees in the United States put together, there are only some 600 species.

HYBRID OAKS

The willows are known to hybridize widely, and the various species of oaks readily cross with any of their near relatives that happen to be growing near. Prof. Henry cites an interesting oak hybrid in England:

"The results of the experimental sowings of the seeds of numerous elms which I made in 1909, together with an investigation into the history of the Lucombe oak, given in a paper read by me at the Linnean Society on the seventh of April, 1910, threw new light on many hybrid trees in cultivation, which had not previously been recognized as such, in spite of the fact that no one could find these trees anywhere in the wild state. The statement often made that a particular tree was a 'variety of garden origin' was no explanation. The Lucombe oak was observed in the Exeter Nursery in 1765 as a seedling, which differed from its parent, a Turkey oak (*Quercus cerris*), in being much more fast in growth and in retaining its leaves during winter till March. Lucombe propagated this seedling by grafting, and believed it to be simply a sport of the Turkey oak. In 1792 it bore acorns from which numerous seedlings were raised, no two of which were alike, while some strongly resembled in bark and leaves the Cork oak (*Q. suber*). Lucombe's son then correctly surmised that it was a hybrid—the flower on the Turkey oak, from which the acorn producing it was formed, having been fertilized by the pollen of an adjoining large Cork oak.

"This case illustrates several well-known laws in regard to hybrids:

"1. The first cross is usually of exceptional vigor, more vigorous than either parent.

"2. When the first-cross reproduces itself by seed, the second generation consists of classes of individuals, which differ from one another and from their parent. The first-cross never comes true from seed, but produces a mixed and varied offspring.

"3. None of the individuals of the second generation equal in vigor the first-cross. This was also clearly established in the case of the Lucombe oak.

"Other common trees, of which no history is recorded, doubtless originated in the same way as the Lucombe oak, namely, as chance seedlings (the result of accidental crossing by wind or an insect), which observant nurserymen or gardeners found desirable to propagate on account of their vigor. The introduction in quantity into Europe during the seventeenth century of North American trees, which grew alongside similar but distinct European species in parks and gardens, was the occasion of considerable hybridization. Trees like the black Italian poplar and the London plane, which have nowhere been seen wild, are intermediate in botanical characters between an American and a

[3] Standish, L. M. What is Happening to the Hawthorns? JOURNAL OF HEREDITY, VII, 6, pp. 266–279, June, 1916.

European species in each case, and are undoubtedly first-crosses. These two trees have been traced back to 1700, about which date the American parents had been long enough in Europe to bear flowers."

THE POPLAR HYBRIDS

The black poplars, it will be remembered, are represented by only two species, one native to Europe and the other to North America, and both having well-marked geographical varieties. The European species, *Populus nigra*, is distinguished from the American tree, *Populus deltoidea*, by the absence of cilia (tiny projecting hairs) on the margins of the leaves, and by the absence of glands on the base of the leaf-blades in front. These characteristics are present on the leaves of the American black poplar. The author designates the glabrous form of the European black poplar as *Populus nigra* var. *typica*, and the pubescent form as *Populus nigra* var. *betulifolia*. The glabrous black poplars of North America are given as *Populus deltoidea* var. *monolifera*, growing from Ontario to Pennsylvania, and *Populus deltoidea* var. *occidentalis*, growing in the region directly east of the Rocky Mountains, from Saskatchewan and Alberta to New Mexico and western Texas. The pubescent American black poplar is *Populus deltoidea* var. *missouriensis*, which grows in the south and southeastern parts of the United States, ascending the Mississippi basin to Missouri. This variety, the author believes, may be taken as the type of *Populus deltoidea*, being most likely to be the form represented by the original description of Marshall.

THE CAROLINA POPLAR

But the chief importance of Prof. Henry's contribution lies in his extensive study of the cultivated black poplars, which has resulted in the valuable discovery that they are almost invariably of hybrid origin. Most interesting to American foresters is the discovery made concerning the Carolina poplar which has been so extensively cultivated here. A great many of our writers have felt that this name, "Carolina poplar," was one invented by nurserymen to overcome the unpopularity of the cottonwood. Some have even believed that the *Populus nigra* of the trade was nothing but our *Populus deltoidea* grown in France and Belgium and returned to America under the false designation. Much relief, therefore, will be experienced by reputable dealers, and by their patrons as well, at having Prof. Henry's determination of the true nature of the cultivated black poplars, and especially the Carolina poplar. Originally the author felt that this tree was merely a form of our *Populus deltoidea*, which had undergone mutation in its floral parts after cultivation in Europe. But now it is determined that the tree is a hybrid between the true black poplar of Europe (*Populus nigra*) and the southern form of our native black poplar (*Populus deltoidea* var. *missouriensis*).

In addition to the Carolina poplar, a number of hybrids are illustrated and described by Prof. Henry which have been derived from the typical black poplar of Europe and the northern form of our black poplar (*Populus deltoidea* var. *monolifera*). These are: *P. serotina* Hartig, *P. regenerata* Schneider, *P. Eugenei* Simon-Louis, *P. marilandica* Bosc., and *P. Henryana* Dode. Further, two forms are described as having arisen from the hybridization of the European black poplar with hybrid forms. These are *P. robusta* Schneider and *P. Lloydii* Henry.

WHY NOT A HYBRID SYCAMORE?

Viewing this work in the light of the previous researches of Prof. Henry on the artificial production of vigorous trees, it will be observed that the author has first demonstrated the practical importance of propagating first generation hybrids. He has then ascertained that the poplars already recognized as especially desirable for cultivation are of hybrid origin. The two papers, therefore, present most forcibly the great importance of initiating intensive work on the artificial production of vigorous trees, and suggest that special attention be directed toward the hybrid-

A CLUSTER OF PECAN NUTS

The pecan is a species of hickory and its nuts, here shown natural size, are enclosed in pods or husks. It is becoming an important crop in the southern states, due to the isolation and propagation of superior varieties instead of dependence on mixed seedlings, as in the past. Photograph from the United States Department of Agriculture. (Fig. 13.)

ization of species of many genera. Our sycamore, *Platanus occidentalis*, for example, is one of the most rapid growing of our hardwood trees. But it is afflicted with a fungus disease which causes the leaves to fall almost immediately after they have appeared in the spring. The restored foliage does not appear to suffer, however, and the tree does not appear to be greatly retarded in its annual growth, for notwithstanding this infirmity, the tree holds first place in size among North American hardwoods.[4] But the tree is being replaced by the European sycamore or plane (*Platanus orientalis*) in street and landscape plantings, as the exotic species appears to be immune to this disease.

[4] Lamb, W. H., in JOURNAL OF HEREDITY, VI, 9, pp. 424–428, September, 1915.

The possibility of producing a vigorous hybrid between these trees is immediately suggested. In fact one may already exist. The London plane, *Platanus acerifolia*, has never been found growing wild and exhibits characteristics intermediate between the American and the European planes. But without doubt, it would be highly profitable to experiment with hybrids of known parentage.

A large field for profitable research is thus opened up by the possibility of artificially producing trees having exceptional vigor. The oaks, chestnuts, lindens, and many other important genera offer a fertile field for experimentation. And at the present time the importance of such work can scarcely be overestimated.

How little has been done is made strikingly clear by Prof. Henry's historical review. He ascribes to Klotzsch the credit for the first hybridization, with the production of pine, oak, alder and elm hybrids at Berlin in 1845. The results were good, but the work attracted little attention.

VIGOROUS WALNUT HYBRIDS

The frequent production of hybrid walnuts in California led Luther Burbank to take up this genus, and he called attention to the valuable qualities of the first-generation hybrids, which grow so rapidly that experienced foresters will scarcely credit the figures. Trees of the so-called Paradox walnut (*Juglans regia*, the Persian or "English" × *J. californica*) at Santa Rosa measure 80 feet in height and 6 feet in girth after fifteen years of growth. The hybrid known as Royal (*J. californica* × *J. nigra*, the black walnut of the eastern United States), appears to be an even more rapid grower, one specimen being credited with a height of 100 feet and a girth of 9 feet after only sixteen years of growth. Another magnificent walnut hybrid is that on the James River, Virginia, which was described by Peter Bisset recently.[5]

As to the quality of the wood of these hybrid trees—a point of prime importance to foresters—Prof. Henry remarks:

"It is a popular belief that fast-grown timber is necessarily soft and comparatively worthless. This is a fact in most conifers; but in one class of broadleaf trees, the wood of which is characterized by large pores in the inner part of the annual ring, the contrary is true, as the faster the timber of these trees is grown the stronger and denser it becomes. This class includes oak, ash, chestnut, hickory, and walnut, the species in fact that *par excellence* produce the most valuable timber.

"All the more reason, then, for efforts to produce fast-growing crosses in the case of these precious trees. To quote from the conclusion of my paper of 1910: 'In countries like our own the only hope of salvation for forestry is in growing timber rapidly; and we have been helped in that by the introduction of fast-growing conifers like the larch, the Corsican pine, and the Douglas fir. But it is essential to grow the more valuable classes of non-coniferous timber.' The difficulty of growing the ordinary species of oak, ash, and walnut is the long period required for their maturity, which renders hopeless, except on the best soils, all chance of an adequate financial return. Without vigorous first-crosses, the most valuable classes of timbers can only be grown in limited quantity."

THE CAUSE OF VIGOR

Although many geneticists have speculated on the problem, no one has yet been able to offer a satisfactory explanation of the extraordinary vigor displayed by hybrids. Some of the Mendelian hypotheses put forward are plausible, but have so far remained unproven. The observed vigor, as Prof. Henry points out, "is distributed over the whole plant, and is as conspicuous in the roots as in the stem and leaves. What we actually observe is not only an acceleration of, but also an increase of cell-division in all parts of the plant. The cells divide very quickly, continue to divide, and thus build up a taller stem, a more extensive root-system, etc.

[5] Bisset, Peter, "The James River Walnut." Journal of Heredity, V, 3, pp. 98–102, March, 1914.

NUTS OF THE SHELLBARK HICKORY

This is one of the commoner hickories of the central United States; its nuts, here shown natural size but without their husks, differ greatly from those of the pecan. The result of a cross between the two species is shown in Fig. 15, the following illustration. (Fig. 14.)

Apparently this alteration in the nature of the division of the cells is not associated with any visible change in their structure. Miss Marshall, who examined for me many sections of the growing points of hybrid poplars and their parent species, could find, as the result of three months' observations, no tangible differences in the size of the cells or nuclei, in the number of the chromosomes, etc.

"It is possible that the stimulus which causes growth (*i. e.*, cell-division) to commence and to continue is some soluble chemical compound or enzyme. The enzyme in the hybrid may be more complex and more effective than the enzymes in the species. Whether the injection of soluble matter obtained from a hybrid into the growing points of one of the parent species would stimulate the latter to increased cell-division, might be worth trying, if the experiment could be carried out.

"Whether the amount of vigor in hybrids is directly associated with the degree of relationship between the individuals which are crossed is a disputable point, but one of practical interest in the selection of parents for crossing experiments. One of my most vigorous hybrids (*Populus generosa*) is derived from two parents so little related that they are placed in two distinct sections of the genus. A cross between two races of the common alder shows considerable vigor, though the parents are so closely allied that they can only be distinguished by the most trivial characters." But whatever the explanation of this vigor may be, no one who has worked with hybrids is likely to question its existence; and that fact is sufficient to make breeding justifiable.

PROPAGATION

"An important question is the propagation of these vigorous crosses, once they are created. The first-cross does not come true from seed, and it would be a great drawback if we were obliged to wait till the newly made trees bore flowers and fruit. The first-cross, in short, can only be multiplied by vegetative reproduction. This is easy when the trees are readily propagated by cuttings, as in the case of poplars and

willows, or by layers, like the Huntingdon and Belgian elms. We may resort to grafting low on stocks, which should be perhaps seedlings of one or other parent. This method will serve when cuttings and layers are not available. It is evident, that, when a valuable hybrid has been produced, it can be propagated and be put on the market, if necessary, without delay."

A few suggestions on the technique of cross-pollinating trees may be useful to those who want to try the artificial production of vigorous trees. Both

HYBRID NUT

Cross between pecan and shellbark hickory, borne by the tree shown in Fig. 12. The nut is natural size, and enclosed in its husk, one side of which has been removed. It is of small value, commercially. Photograph from the United States Department of Agriculture. (Fig. 15.)

male and female flowers should be protected with bags, in order to prevent the possibility of a mix-up in heredity through the presence of foreign pollen. The male flowers should be bagged a week before they shed their pollen, while the female flowers may be protected for a fortnight before the stigmas are receptive and a week after the cross-pollination has been made. If the tree with which one is working has perfect flowers and is to be used as the seed-bearing parent, the pollen-bearing organs must of course be removed at an early stage, with a needle-pointed forceps. This operation is a delicate one, particularly if it must be carried out at the top of a lofty tree, swaying in the wind. Sometimes it may not be necessary, if the flowers are protected by nature from self-pollination. In the case of the ash and elm, for example, the stigmas are receptive some days before the anthers shed their pollen. Under these circumstances, the pollen from another species may be applied to the stigma, and no attention paid to the anthers.

HANDLING TREE POLLEN

"Pollen spoils by keeping, but it often must be kept for some time till the stigma of the female parent is receptive. It is often obtained from distant countries where trees of the desired species, flowering early, can be found. It is best kept in a small glass tube either corked or plugged with cotton wool. Pollen is usually collected by cutting off the flowering twigs and placing them on white paper in a dry place for one or two days.

"Pollen is applied with a camel's hair brush, and a minute quantity is sufficient for each stigma. The stigmas are to be pollinated when receptive, indicated by the presence on them of a sugary solution or by their change to a brighter hue. Pollen grains may not be able to germinate on the stigma of another species, and yet be capable of fertilizing it, if germination could be induced. The transference of a drop of the substance secreted by the stigma of the pollen-bearing species to the stigma of the other parent might induce germination. The best time for pollination is in the warm part of the day, between 11 a. m. and 3 p. m. in early spring. Cold, wet days should be avoided."

It is not a very long time, in the history of the world, since the English gardener Fairchild produced the first

artificial hybrid plant on record, in 1715, by fertilizing the stigma of a carnation with the pollen of a Sweet William. Since then, the process of artificial cross-pollination has transformed commercial horticulture and agriculture. There is good reason to believe that it will find an equally widespread application in forestry, and it is probable that Europe will undertake the work rather than the United States. The American continent still contains a large supply of virgin forest. Many years ago, however, the European forests passed the virgin stage and became the objects of thorough silvicultural management They became an agricultural crop. Even in normal times the planted timber is recognized as entirely inadequate for the domestic requirements, but the present war has placed a responsibility upon the European forester greater than can possibly be appreciated. Timber reconnaissance, after the close of the war, will reveal an awful destruction of forest growth. Never before in the history of the world has military activity been so destructive. The great battle wave, extending from Ostend to Belfort, and from Riga to Persia, flows to and fro, while artillery of unprecedented caliber, great jets of liquid fire, and clouds of deadly gases, reduce the forests to desolation. The strategic value of the forests, so often mentioned in official dispatches, but too plainly indicates approaching necessity for intensive reforestation projects, a work which will be so imperative as to render studies on accelerated reforestation of the greatest economic importance. The investigator, therefore, who can produce trees which will exceed the natural species in vigor, will be rendering the most valuable public service. If he can accelerate the reforestation of the battlefields of Belgium and France, he will be rendering a priceless contribution to the national welfare.

Wanted: A Plant Breeder

There is a possibility of an opening in teaching plant breeding in the Division of Agriculture at the Iowa State College. The candidate should have had some practical experience along plant industry lines, preferably in horticulture. Further information may be had by addressing Professor S. A. Beach, head of the Department of Horticulture and Forestry, Ames, Iowa.

Eugenics and Military Preparedness

The relations of war to national eugenics have often been pointed out; the eugenic aspects of military preparedness are less often considered. Starting with the axiom that preparation for war should bear in mind the necessity of safeguarding national eugenics as far as possible, we arrive at the following conclusions:

1. A military establishment should be composed of men of as advanced an age as is compatible with military efficiency.

2. It should not be made up of celibates. Short enlistments might be valuable in favoring marriage.

3. Universal conscription would appear to be better than voluntary service, since the latter is highly selective.

4. Officer's families should be given an additional allowance in pay for each child. This would aid in increasing the birth-rate, which appears to be very low among army and navy officers.

5. Means should be worked out to establish men, at the end of enlistment or the end of hostilities, as rapidly as possible economically, so that they may not be forced by economic pressure to refrain from marriage or parenthood.

6. "Preparedness," in the ordinary sense of the word, is highly desirable in order that the loss of men may be minimum, especially during early days of war when, if unready, a nation would probably lose heavily.

These appear to be some of the considerations, which should be regarded in advance of war, if the necessity for defense is to be made as little of a handicap, eugenically, to a nation as possible.

EXTRA FINGERS AND TOES

THE occasional appearance of one or more fingers or toes in excess of the normal number is technically known as polydactylism, and offers one of the most puzzling problems in heredity. Generally, the mode of inheritance of abnormalities of this sort is fairly plain and follows a simple scheme, but polydactylism has so far baffled all attempts to reduce it to rules; it appears to be almost anarchical.

One of the reasons for this doubtless is that polydactylism may be due to a number of different causes. The guinea-pig may be cited in this connection, for it offers abundant material for study. It ordinarily has three toes, but in 1905 Prof. W. E. Castle of Harvard University found a four-toed specimen which he bred and from which he has succeded in establishing a "four-toe" strain. It has now gone through fifteen or twenty generations, yet the character is not absolutely fixed. Pure-bred four-toes, when mated with their like, will occasionally produce three-toed individuals (which, however, are able to transmit the four-toe character to their offspring), just as pure-bred three-toed individuals when mated together will occasionally, although more rarely, produce a four-toed individual. Prof. Castle describes the heredity of the character as "partly blending, partly segregating;" that is, its inheritance is that of a simple Mendelian character, but one whose visible expression varies greatly. The character is neither dominant nor recessive, he holds, but is directly modified by crosses. "It is quantitatively variable," he writes, "so that by selection one can establish high-grade or low-grade strains of polydactylism, and normals of polydactylous ancestry often transmit the character. It is as good a Mendelian character as many others, but (1) lacks dominance, (2) is variable, and (3) is affected by crosses; *i. e.*, blends to some extent or is contaminated. Strong support for this interpretation is afforded by a recent paper on the inheritance of flowering time in peas (Hoshino, 1915) in which it is shown that the character studied is subject to partial blending but is clearly Mendelian, for it is coupled with the color factor in crosses of red with white varieties."

MENDELISM IS QUESTIONABLE

A Mendelian character with all the exceptional behavior which Dr. Castle describes is, however, a rather difficult character to follow, and many geneticists prefer to say that polydactylism in guinea-pigs is not yet demonstrated to be a Mendelian character.

The explanation of the appearance of this fourth toe in guinea-pigs is simple: it represents merely a reversion to the ancestral condition. The ancestor of the guinea-pig, in fact, had five toes, and it is therefore likely that a fortunate geneticist will some day find this fifth toe cropping out, and thereby succeed in reestablishing a five-toed strain. Prof. J. A. Detlefsen of the University of Illinois actually found one such animal in his breeding experiments, but it was sterile and could not be used to produce a new race.

Fowls, too, had five-toed ancestors, and although most birds of the present day have only four toes, a fifth toe sometimes appears. It might naturally be supposed that this represented the cropping out of the ancestral character; but Bateson and Davenport have shown that as far as the best known breeds of domestic fowl—the Dorkings and Houdans—are concerned, the fifth toe is not a reversion, but an abnormality due to the splitting of one of the toes (the hallux). How such a race might originate is graphically shown by the accompanying photograph (Fig. 16) of a Racing Homer pigeon, sent in by I. O'Neill Brenan of Brisbane, Queensland. Here it is clearly seen that one of the toes has split, during development, producing a bird with five toes. This bird, bred to one of its own sisters, produced one squab that had an

A PIGEON WITH FIVE TOES

As a rule, extra toes are rare in birds, but a few breeds of domestic fowl have regularly five toes. These breeds probably originated in such a bird as the pigeon shown here, the hind toe being split. The split toe is inherited to some extent, and long continued breeding and selection would doubtless result in the establishment of a five-toed breed of pigeons. Photograph from I. O'Neill Brenan, Brisbane, Queensland, Australia. (Fig. 16.)

extra toe on one foot. If sufficient effort were made, probably a strain of five-toed pigeons, corresponding to the five-toed Dorking fowls, could be established on this basis. It would be many generations before all the birds had five toes, but if the five-toed individuals were regularly selected for breeding, it can hardly be doubted that this selection would eventually produce an effect. The relative constancy of the five-toed condition in Dorkings and Houdans, as compared with instability in guinea-pigs is probably due very largely to the fact that the domestic fowls have been stringently selected for five toes.

The five-toed condition in birds is, as has been said, very rare save for the domestic fowl. Geneticists have made numerous crosses of the five-toed breeds with four-toed ones, in order to work out the inheritance of the trait, but they have not met with great success. Professor Castle holds that it is a Mendelian trait and that its irregular behavior goes to prove that Mendelian characters are variable; but most geneticists do not admit that Mendelian characters are variable in this way, and are therefore confronted with considerable difficulty in making the evidence conform to Mendelian expectations. Bateson can only suggest that polydactylism "is perhaps due to a dominant factor which

LEFT HAND OF ITALIAN IMMIGRANT

The first joint of the little finger appears to have split in two at a very early stage in the development of the hand, with the result that two little fingers have been produced. This seems to be the way in which extra fingers and toes ordinarily appear in man. In this case the extra fingers are complete in joints and tendons, but often they are much more rudimentary. (Fig. 17.)

RIGHT HAND OF ITALIAN IMMIGRANT

The extra finger is almost identical with that of the left hand, shown on the opposite page. Abnormalities of this sort are usually hereditary, although the heredity is frequently irregular. From an X-ray photograph made by the U. S. Public Health Service at Ellis Island, New York, and sent in by assistant surgeon Howard A. Knox. (Fig. 18.)

can be inhibited or suppressed as the result of the presence of other factors. In poultry," he continues, "we know by experiment that the presence of an extra toe may behave as a dominant, following the simple rule with fair regularity, but in other families the number of dominants produced is too small and transmission may occur through normals destitute of extra toes. Such facts point to the existence of some unknown complications in those families."

POLYDACTYLISM IN MAN

In man it is well known that an extra finger or toe sometimes appears; but as we know of no ancestor, within hundreds of millions of years, who had more than five, human polydactylism can not be like that of the guinea-pig—the appearance of an ancestral character. It may, therefore, most conveniently be assumed to be due to a splitting of one or more of the ordinary digits, which may be so extreme in degree that the individual possesses a "double hand" of 10 fingers attached to one wrist. The most ordinary type consists of the presence of one extra finger, as is shown in the Italian immigrant whose hands were photographed at Ellis Island, N. Y., recently (figs. 17, 18). Dr. Howard A. Knox, assistant surgeon of the U. S. Public Health Service, who sent in these photographs, calls attention to the interesting feature of the case—that the extra fingers function completely, each having fully developed joints and tendons. They seem to have been produced by a division of the little fingers in two.

Dr. Knox investigated the family history of the immigrant as far as was possible, and found that one uncle (probably maternal, but there is doubt on this point) has an extra digit on the right hand only. But its location was the same as that in the subject here shown. The immigrant's second son, about 23 years of age, has one extra digit on each hand and each foot.

Such a family history is fairly typical of most of those which describe polydactylism in man. The condition reappears in almost every generation, but it is frequently not quite the same, and appears to be distributed without regard to any regular form of procedure. Davenport shows this plainly, despite his optimistic expression, when he writes, "The peculiarity of supernumerary fingers and toes is one that is inherited in nearly typical fashion. I have worked extensively on polydactylism in fowls and there can be little doubt that the character behaves the same way in man. The extra toe is due to an additional unit so that when one parent has the extra toe the children will also have it. However, it sometimes happens that the offspring fails to produce the extra toe; but such persons, becoming in turn parents, may produce the polydactyl condition again. . . . The eugenical conclusion is: polydactyl persons will have at least one-half of their children polydactyl. Those quite free from the trait, though of the polydactyl strains, will probably have only normal children."

This conclusion may be a rough approximation to what usually happens, but it cannot be held to be an exact statement of the mode of heredity of polydactylism. Nor is any one in a position at present to give such an exact statement. We can only say that the appearance of extra fingers or toes (they frequently go together) is inherited to a high degree, but without any discoverable regularity. Fortunately, the trait is one that possesses no eugenic significance, and we can therefore view our ignorance with more complacence than if the trait really possessed importance to the race.

Origin of the White Blackberry

The white blackberry put in the trade by Luther Burbank some years ago is a good example of the production of a marketable fruit by the recombination of existing characters. The parents are said to be Lawton's blackberry and an insignificant cultivated bramble of the eastern states. The latter has pale amber berries and is probably an albino variety of the same species of blackberry as Lawton's. Burbank crossed the two and selected from the progeny (presumably in the second generation) individuals that possessed the shape and qualities of the Lawton and the color of the bramble.

CHANGE OF SEX IN HEMP

Mutilation Makes Female Plants of Cannabis Sativa Produce Male Flowers—Change in Nutrition Probably Responsible for the Result

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THE possibility of altering normal sex ratios in dioecious species of plants and animals is one of the most debatable topics of genetics. The experimental results thus far recorded are not only varied but occasionally contradictory. When viewed as a whole, however, they seem to indicate that maleness and femaleness are not always fixed characters, but frequently appear more like responses of the developing organism to external stimuli.

Of all the external factors that have been supposed to determine sex, food ranks first. Indeed, many biologists now believe that the determination of sex is in the last analysis a problem of nutrition. It is also remarkable that in nearly every instance in which food affects the sex ratio, favorable nutritive conditions tend to produce females and unfavorable conditions males.

Nevertheless the food theory of sex determination fails to account for the sex ratio of 1:1 commonly found among unisexual individuals.

A Mendelian theory of sex determination now popular not only explains normal sex ratios in dioecious species but receives considerable support from studies of sex-linked inheritance. The fundamental basis of this theory as expressed by a distinguished geneticist is that "sex has its beginning in gametic differentiation and is finally determined beyond recall in the fertilized egg by the nature of the uniting gametes." The hypothesis also carries the assumption that one of the sexes is heterozygous for a sex factor and the other homozygous.

Though subject to criticism, this theory is admirably adapted to the factorial method of analysis and appears to explain many facts of sex inheritance.

The difference of opinion regarding the effect of external stimuli upon sex ratios has led the writer to investigate the following questions: (1) Can sex ratios of dioecious plants be altered by modifying conditions external to their germ cells? (2) Is the alteration thus obtained limited to individuals of one sex? (3) How do the results harmonize with the Mendelian conception of sex determination?

MATERIAL

As hemp is composed almost wholly of distinctly unisexual individuals it was chosen as a favorable species for the investigation of sex ratios. In addition to its separation of the sexes, it develops in its females a heavy and dense growth of foliage by which they may readily be distinguished from the males. In fact, at the time of flowering the plants may be recognized at a distance as male and female.

The proportion of males to females which normally appeared under the field conditions where the experiments were made was approximately 1:1. Monoecious individuals also appeared in relatively small numbers, as will be subsequently shown, but they were distinctly female in type and preponderatingly female in flower development.

METHODS

Disturbances of the plant's physiological equilibrium were induced by the removal of flowers and vegetative parts and by the injection of chemical substances into the stem.

In addition to the removal of parts some plants were given further treatment by enclosing their tops in Manila bags to diminish the intensity of the light falling upon the newly developing flower buds.

MALE AND FEMALE HEMP PLANTS

At the left is the female or pistillate plant, at the right the staminate or male. In addition to the difference in flowers, the two sexes differ markedly in habit of growth, as is seen. By mutilation, each sex can be induced to take on the characters of the other; a change which may be due to interference with the plant's normal process of nutrition. Photograph by Lyster H. Dewey. (Fig. 19.)

The use of chemicals was limited to the year 1909. To facilitate their introduction small holes were cut into the pith cavities and afterwards closed with paraffin.

In 1914 no leaves or branches were detached but all flowers and flower buds were removed from branches and stem.

The counting of the flowers—a laborious process—was done by fives and tens but this nowise interfered with the observance of the staminate and pistillate character of the flowers.

EXPERIMENTS

Plants were grown for the investigations at Madison, Wis., in 1909, 1912, 1913 and 1914, but owing to a poor stand in 1912 and the writer's absence in 1913 when the treatments should have been given, the experiments for these two years were not completed. Hence, the results are limited to the two years' investigation in 1909 and 1914.

As no further opportunity has been found to continue the work it seems better to publish the results now obtained than to wait an uncertain period for the accumulation of further data.

In 1909, male and female hemp plants were used in approximately equal numbers. As each plant had at the time of operation already borne a large number of exclusively staminate or exclusively pistillate flowers, any degree of visible monoeciousness could easily have been detected.

The 263 plants treated were mutilated by removing their flowers and flower buds, their leaves, and varying proportions of their stems; the tops of twenty were also bagged; and the stems of sixty others injected with 1 to 2 ounces of one or more of the following chemical solutions: calcium nitrate 1/10%; zinc sulphate 1/10%; dextrose 5%; maltose 5%; peptone 1%; asparagin ½%; potassium iodide 3%; pyridin $\frac{n}{25}$; formic acid $\frac{n}{16000}$; acetic acid $\frac{n}{60}$, $\frac{n}{30}$; sodium hydrate $\frac{n}{300}$, $\frac{n}{100}$, $\frac{n}{60}$.

Alteration of sex occurred under several different treatments. Either covering the top with a Manila bag or injecting into the stem a solution of dextrose, maltose, glucose, asparagin or pyridin was accompanied by a modification of sex. In each instance, however, the removal of parts constituted a part of the treatment. In fact the removal of parts was the only factor common to all the sex-developing responses. Hence it was probably the chief cause of sex alteration.

Of the 163 plants which reproduced flowers after treatment twenty-nine or 17.8% developed some flowers of the opposite sex. Four of these plants were males, the other twenty-five females.

TABLE I.—*Proportion of Monoecious to Dioecious Hemp Plants Found on Successive Dates at Madison, Wis., in* 1909

Date of examination	Number of dioecious plants: Male	Number of dioecious plants: Female	Number of monoecious plants	Percentage of monoecious plants	Field
September 23	49	43	8	8.0	A
September 27	96	99	5	2.5	B
September 30	0[1]	174	26	6.5(13.0)	A
October 1	0	187	13	3.25(6.5)	B
October 1	0	84	16	8.0(16.0)[2]	B
October 18	0	47	3	3.0(6.0)	B

[1] As no male plants under these conditions formed perfect flowers, the omission of male plants in the counting records from September 30 to October 18 gives the percentage of monoeciousness for only the female type. The true percentages of monoeciousness are one-half the values inclosed in parentheses as represented by the figures at their left.

[2] Late maturing plants.

It may be argued that temperature or some other factor due to an advancing season was the effective stimulus rather than the removal of parts but this makes little difference as it would still be an external stimulus. The same statement may be made with regard to the possible effects of chemicals and diminished light intensity. However, the percentage of monoeciousness was determined on several successive dates in two neighboring fields designated respectively as A and B. These results are presented in Table I.

The percentage of monoecious plants in field A was much larger than in field B. This may have been due to wider spacing, as the plants in field A stood farther apart than in field B and consequently were larger and better fed; or it may have been caused by some inherent difference in the seed.

If we exclude the records of late maturing plants, made on October 1, the table shows no evidence of an increased percentage of monoeciousness as the season advanced.

The results for 1914 are presented in Table II. As they show unmistakeable evidence of sex alteration from the use of external stimuli they are published in detail. Both the number and character of flowers removed as well as those that subsequently developed are included.

As shown by the table, sex was not altered by bagging the tops but was very decidedly altered by the removal of flowers. Of the fourteen male plants that formed flowers after the operation only three developed pistils but every female plant produced both stamens and pistils in abundance. In fact the proportion of stamen-bearing flowers formed on female plants greatly exceeds that ordinarily formed on monoecious plants.

As a check on the experiments recorded in Table II, twenty-eight female plants were tagged at the time of the foregoing operations and carefully examined at the end ot the season for the appearance of male sex organs but not a single stamen had developed.

It is evident from the experiments and their checks that changes in sex were induced by the removal of flowers and flower buds, probably through alteration of the food supply. The production of pollen and ovules is an exhausting process. As soon as male hemp plants shed their pollen they turn yellow and die. The removal of flowers and flower buds from the female plants when their reserve food is at a minimum probably makes the nutritive conditions less favorable for the development of the new buds and in accordance with the food theory of sex determination, causes an excess of male development. The appearance of pistillate flowers upon a few treated male plants, however, is difficult to explain upon this basis unless we assume that these particular flowers received more than their share of the food supply.

If the effect of flower removal on the food supply has been properly interpreted, it is evident that the proper method of inducing pistillate development in male plants is through high feeding, especially about the time of flower formation. This should be done through the soil in such a way as not to interfere with the plants' normal physiological activities.

CONCLUSIONS

The foregoing experiments show that sex of hemp is alterable by the removal of flowers. While only a few male plants produced pistils, they constituted 14 to 21% of the total number of males reproducing flowers after the operation. It is quite probable that if the proper stimulus were used pistil formation could be induced in all the males. The females were very responsive to the stimulating effect of flower removal. In fact in the second year's experiments every female operated upon produced an abundance of stamens.

The results do not seem to support the theory that sex is wholly a matter of zygotic constitution—one dose or amount of an inherited sex factor producing one sex and two the other, but indicate that both males and females are potential hermaphrodites as believed by Darwin and Strasburger.

TABLE II.—*Alteration of Sex Ratios in* 1914

Plant number	Number of flowers removed[2]		Additional treatment	Number of flowers appearing after operation			
				Under sack		On remainder of plant	
	Male	Female		Male or perfect	Female	Male or perfect	Female
1	16,030	0	Top bagged	640	0	1,040	0
2[1]	55	9,780	Top bagged	101	432	8,420	621
3[1]	560	5,500	Top bagged	875	97	5,085	5,910
4	0	7,355	Top bagged	43	980	722	8,100
5	0	7,370	Top bagged	11	65	655	3,280
6	18,875	0	Top bagged				
7	0	9,090	Top bagged	250	320	210	1,300
12	10,280	0	Top bagged	630	0	4,860	0
13	0	9,690	Top bagged	56	415	225	4,360
14	0	4,640	Top bagged	0	0	950	4,295
15	0	10,640	Top bagged	42	385	463	2,510
16	25,185	0	Top bagged	870	0	10,150	0
17	0	3,690	Top bagged	32	450	505	2,840
18	20,275	0	Top bagged	575	0	4,535	0
19	0	7,450	Top bagged	120	1,265	605	5,580
22	11,520	0	Top bagged				
23	0	11,680	Top bagged	890	780	4,750	9,340
27[1]	341	8,990	Top bagged	720	750	3,250	3,870
37	23,910	0	Top bagged	480	0	2,590	0
38	28,370	0	Top bagged	540	0	5,140	3
39	0	7,820	Top bagged	15	420	52	2,530
40	0	10,650	Top bagged	184	470	269	3,410
41	0	9,380	Top bagged	5	880	3	2,340
42	0	8,920	Top bagged	258	470	275	3,490
43	0	8,220	Top bagged	75	380	125	7,850
46	0	9,370	Top bagged	125	350	336	3,160
8	17,450	0	None			840	0
9	0	9,625	None			550	4,575
10	8,140	0	None			0	461
11	0	10,211	None			375	6,735
20	0	10,360	None			2,005	2,270
21	23,845	0	None				
24	0	8,240	None			3,210	9,480
25	0	10,770	None			2,705	8,390
26	0	9,110	None			267	4,560
28[1]	60	5,680	None			382	8,460
29	23,500	0	None			7,205	0
30	0	10,290	None			2,280	10,220
31	17,320	0	None			9,110	0
32	9,750	0	None			2,250	1
33	0	8,460	None			215	5,280
34	0	10,530	None			850	8,410
35	0	9,760	None			45	6,770
36	23,440	0	None			1,060	0
44	10,440	0	None			830	0
45	15,360	0	None			1,560	0
47	0	6,890	None			39	370
48	0	4,140	None			400	1,120

[1] Monoecious plants.
[2] These were all the flowers on the plants at the time of operation.

CONCERNING PREPOTENCY

The Idea Belongs to Practical Live-Stock Breeders, Not to Geneticists—How Prepotency May be Obtained by Breeders—How It May Be Explained By Geneticists.

THE EDITOR

The term "prepotency" is one which originated among practical breeders, not geneticists. It is a descriptive term which has been found useful for covering a number of different, but related, facts. It has the further merit, scientifically, that it describes these facts without implying adhesion to any hypothesis which, in its application to these facts, has not yet been proved.

It is as a descriptive term that live-stock breeders habitually use the word, and it is in this sense that I used it in writing about Brigham Young; An Illustration of Prepotency, in the February issue of this journal.

A member of this association, who prefers to remain anonymous, writes that he is "greatly moved" by the article, which ascribes the quality of prepotency to Brigham Young; first because he doubts whether my use of the term prepotency is correct and second because he doubts whether on the evidence presented Brigham Young had the superior influence as a parent which has been ascribed to him. As prepotency is a subject of general interest and of first importance to stock breeders as well as to students of genetics, it is worth while to give it further consideration.

First let us decide what prepotency means. The Century Dictionary is in accord with the usage of the breeders when it defines the word as meaning "preeminent in power, influence, force or efficiency; prevailing; predominant." As applied to heredity the dictionary says it would mean *of superior power or influence in hereditary transmission*, as a quotation cited from Darwin shows. If we turn to Darwin's discussion of the subject in *Animals and Plants*, we find that he was unable to formulate any general rules concerning prepotency, superior influence seeming to inhere (1) in some cases in one character as against a contrasted one (cases we should now describe as due to Mendelian dominance), while in other cases superior influence seemed to inhere (2) in one sex (cases which he described as sex-limited inheritance and which are now known to form a special category of Mendelian inheritance). In still other cases (3) Darwin believed one race or species to have superior influence in crosses with another race or species.

DARWIN'S EXAMPLES

As examples which we should place in category (1) Darwin mentions "purple-blossomed" peas as prepotent in crosses with "white-blossomed," and fowls of normal plumage as prepotent in crosses with silkies. Fantail pigeons he regards as lacking prepotency in crosses with pouters and barbs, yet records the occurrence of a silky sub-variety of fantails which invariably transmits its silky feathers in crosses. Hence lack of prepotency does not inhere in fantails as regards all their characters but only as regards their fantail character. Other examples belonging in our category (1) noted by Darwin are dun color in horses, dark spotting in sheep, hornlessness in cattle, normal flowers of the snapdragon and of Linaria in crosses with peloric flowers.

As examples which we should place in category (2) Darwin mentions color-blindness in man, "the hemorrhagic diathesis" (haemophilia?) and certain plumage characters of poultry and pigeons more often transmitted by males than by females.

As examples of category (3) Darwin mentions the ass as prepotent in crosses with the horse, "the prepotency in this instance running more strongly through the male than through the female ass, so that the mule resembles the ass more strongly than does the hinny." He

IS THIS SIRE PREPOTENT?

A West African Negro, his English wife, and their nine children. To a white observer, the father would appear at first sight to be prepotent, in determining the visible characters of the offspring; but, says a member of this association, "these children resemble their *mother* as well as their father. The children are of intermediate skin-color, hair form, breadth of nose and thickness of lips. The characters of the mother are as truly dominant as those of the father." He therefore considers it ambiguous and inaccurate to say that the Negro and the Chinese are "prepotent" in crosses with the white race. After Bond, *Journal of Genetics*, II, 2. (Fig. 20.)

further cites on the authority of Gärtner some species crosses of Nicotiana (tobacco), stating that *N. vincæfloræ* is prepotent in crosses with *N. paniculata*, but that in crosses with *N. quadrivalvis* the latter is prepotent. Numerous and extensive studies made in recent years of Nicotiana hybrids show beyond question that the prepotency (dominance) inheres in single characters, not in the characters of either parent as a group. The same is in all probability true of horse-ass hybrids, but the sterility of all such hybrids has precluded demonstrative breeding tests.

On the whole we find in Darwin's examples abundant illustrations of Mendelian unit-character inheritance, but no clear case of anything else. Darwin was evidently confused on the subject; and of course he knew nothing about Mendelism. He failed to distinguish between prepotency of one or more *characters* in an individual and prepotency of the *individual as a whole*.

The live-stock breeders of the present day likewise fail to make this distinction. In general, they speak as if prepotency were a function of the individual. Many modern geneticists object to this attitude, holding it to be vague and confusing; they are unable to picture clearly to themselves any way in which an animal could be prepotent as a whole, although their work with different unit-characters leads them easily to understand that an animal might have a number of prepotent or, tech-

nically, dominant characters, and therefore *seem* to be prepotent as an individual.

"But," writes my correspondent, "if there really exist, as Darwin supposed and as the literature of breeding based on pre-Mendelian conceptions implies, individuals or races having superior power of hereditary transmission as regards all their characters, their existence must be regarded as of the greatest theoretical interest and practical importance, and no effort should be spared to discover them."

THE CASE OF BRIGHAM YOUNG

The illustration of Brigham Young in the February issue of this journal, seemed to my correspondent to be an attempt to demonstrate a case of individual prepotency. As a fact, I expressed no opinion as to whether the prepotency was general or was confined to certain characters; I enumerated certain characters as indications of prepotency and left the reader to interpret them as he liked. Shape of mouth and nose were mentioned as being strikingly alike in father and daughters, and a friend of the Young family was quoted as saying that "all the daughters are distinctly Youngs in feature, voice, appearance and temperament. . . . None is great as their father was great, but all are Youngs."

Interpreting this as a claim of general or individual prepotency, my correspondent writes:

"Is the case of Brigham Young evidence of individual or racial prepotency? The evidence is incomplete. We may admit that the daughters look like their father. Most daughters do. They probably also look like their mothers. We have no means of judging whether they look *more* like one parent than the other, because the picture of the other parent is not given for comparison. Yet this is the very point on which we are asked to pass judgment. The jury calls for *Exhibit B*, the pictures of the mothers, before bringing in a verdict.

"There are in the group of daughters, according to the legend, three pairs of full sisters. These three pairs are plainly more like each other in features and expression than any other pairs which can be formed within the group. This fact shows that the mother as well as the father had influence in determining the features of these daughters. Which had the *greater* influence, the mother or the father, we have no means of judging.

"The author speaks of shape of nose and mouth as being features in which resemblance is shown to the father. Suppose this be granted. No two have noses and mouths exactly alike. Perhaps the mothers had something to do with these differences. But even if there were practical identity between father and daughters in shape of nose and mouth, we should be dealing with two single characters only. These might be *dominant characters*, but that would not prove Brigham Young a *dominant parent*.

"Suppose we examine a photograph, which Bond (*Journal of Genetics*, 1912) has published, of an English woman, her West African husband, and their nine children, for evidence of prepotency. (See Fig. 20.) The children all have dark skin, black curly hair, broad noses and thick lips, in all of which features they resemble their father. Surely, you might say, this is a prepotent sire. But these children resemble their *mother* as well as their father. The children are of *intermediate* skin-color, hair form, breadth of nose and thickness of lips. The characters of the mother are as truly dominant as those of the father. A white race calls the children *black*-hybrids, but a black race might with equal propriety call them *white*-hybrids. A study of later generations would probably show also that the several characters observed in the children vary independently of each other in later generations, that they are not a group of correlated characters at all."

The illustration given is particularly pertinent, because anthropologists have often spoken of the negro (and also the Chinese) as prepotent in racial crosses with whites. It cannot be denied that this is a loose use of the term, which is not likely to be of much value to science. I do not consider that the illustration of the negro-white

cross is wholly parallel to the illustration of Brigham Young and his daughters; I am still of the opinion that the daughters, despite the fact that they come from eight different mothers, resemble each other as much as do ordinarily the children of a single mother; and I am of the opinion that the father may therefore properly be called prepotent, as the term is ordinarily used. It seems to me that the uniformity of mouth, nose and ears furnishes a good illustration. But I certainly would not lay much weight on the illustration as an evidence of the existence of either character prepotency or individual prepotency; it is nothing more than an illustration, although as good a one as I have ever seen in human material. To get any real light on the problem, I think we must stay in the field of livestock breeding, where the problem arose.

MR. ROMMEL'S OPINION

To get light here we called on the secretary of the American Genetic Association for information as to the attitude of intelligent modern breeders; he was asked particularly whether in regard to individual prepotency geneticists had from their more limited experience overlooked a principle recognized among practical breeders. His reply is as follows: "Concerning individual prepotency, I will say that this has been made the subject of two of the regular Saturday afternoon conferences of the officers of the division. It is the consensus of opinion that from the standpoint of the geneticist there is no such thing as individual prepotency in animals; that is to say, that no animal is prepotent in every character. There have been many animals that were prepotent in certain characters, or even in many characters. From the standpoint of the practical breeder there is individual prepotency in that certain animals have been prepotent in producing the things for which the breeder is striving.

"The inbreeding by which a character of interest is made prepotent will automatically make the factors affecting other characters homozygous, will give some prepotency to these characters (as far as they are due to dominant factors), and will give the individual an appearance of individual prepotency.

"As an example may be mentioned the case of the Standard-bred stallion, Peter the Great, 28955. He has 216 sons and daughters with records of 2.30 or better. This is a good example of prepotency in the matter of speed and included with this must be various other characters, not measurable perhaps, which enable these horses to go a mile in such fast time.

"There are on record a few other stallions which have more sons and daughters with records of 2.30 or better, but none of these stallions is living at the present time.

"As other examples may be mentioned famous Holstein and Guernsey bulls, famous because of the fact that they have sired a large number of daughters which have made records large enough to admit them to the Advanced Register. In order to make these records these animals must have had the requisite constitution, capacity, and nervous temperament, without which such records would not have been possible. The sires were undoubtedly prepotent in such characters but these are not measurable.

"One of the best examples of prepotency in beef cattle is that of the Shorthorn bull Avondale. This bull has sired a large number of excellent bulls and heifers indicating that he was prepotent in a large number of characters.

"I trust that this statement will give you a clear idea of what is in our minds; I think that it is the idea in the minds of practical breeders.

"Very truly yours,

"GEO. M. ROMMEL,

"*Chief, Animal Husbandry Division, U. S. Department of Agriculture.*"

Evidently, then, the idea of individual prepotency which the breeders hold, and by which they mean that a certain animal has superior influence in hereditary transmission, covers many causes or supposed causes. Thus in one connection or when used by one person it may mean (as it actually does in

Darwin's "Animals and Plants," (1) Mendelian dominance (2) sex-limited Mendelian inheritance or (3) predominance as a group of the characters of one parent over those of the other. In other cases it may mean only (4) a high degree of excellence as regards some inherited character or the ability to transmit the same.

BREEDERS' EXPLANATIONS

If we go a little farther and inquire what explanations the breeders have offered for the various results that they lump together under the name of individual prepotency, we find these:

1. "Maximum efficiency of all organs," as indicated "in the expression of the countenance and in the general bearing, behavior and carriage."[1] or, in a word, vigor.
2. Existence of the breed for a long period of time "on a favorable soil."[2]
3. Length of time in which a variety or breed has been under domestication. "It is generally assumed that an old species or variety is prepotent over a more recent species or variety."[3]
4. Mutation. "High prepotency does not arise through normal variation, but must rank as a heritable sport or aberrant variation."[4]
5. Accompaniment of a mutation. "In nature, prepotency may arise spontaneously and abruptly along with sports in one or more directions."[5]
6. As a result of natural selection, through a gradual process of evolution.[6]
7. Inbreeding.
8. "Purity of blood."
9. Sexual development.[7]
10. "The lack of affinity in certain characters, which makes it difficult to blend them."[8]
11. Telegony.[9]
12. Maternal impression.[10]
13. Physiological relation between dam and offspring, which is supposed to make the dam prepotent over the sire.[11]
14. Relative maturity of parents, old animals being thought to be prepotent over very young ones.[12]
15. Degree of ripeness of germ-cells, fully mature gametes being prepotent over immature gametes.[13]
16. Relative strength of "nervous organization"—whatever that may mean.[14]
17. Degree of functional development, either of an individual or of his immediate ancestors.[15]

Certainly we have here a beautiful example of a term that means all things to all men. Some writers regard it clearly as a function of individual characters, others regard it clearly as a function of individual animals, others do not stop to ask what it does mean; others look on it as a highly variable quantity, as J. Cossar Ewart, who says:[16]

"An animal (male or female) may be prepotent in some respects and not in

[1] Marshall, F. R. Breeding Farm Animals, p. 90. Chicago, 1911.
[2] Von Oettingen, B. Horse Breeding, p. 222. London, 1909.
[3] Ewart, J. Cossar. The Pennycuik Experiments, p. xii. London, 1899.
[4] Galton, Francis. Nature (London), July 14, 1898.
[5] Ewart, *op. cit.*, p. 44.
[6] *Ibid.*
[7] Cf. Dexter, William Hart. Methods Used by the American Jersey Cattle Club in Perfecting the Breed. In A. B. A. Proc. IV (1908), p. 37: "Prepotency will be shown in the general appearance, which should be thoroughly masculine in character, with a harmonious blending of the parts with each other. There should be evident vigor, style, alertness, and a resolute appearance with abundant nervous energy."
[8] Shaw, Thomas. Animal Breeding, p. 105. New York, 1901.
[9] *Ibid.*
[10] Or even "paternal impression"! A genealogist writes me with reference to the Brigham Young photographs: "I fancy that I can see that the force of affection, which may exist in the heart of either parent at the time of creation, determines where the likeness will fall. . . . The one who loves the most copies in the offspring the features of the one loved."
[11] Mentioned by Davenport, E. In Breeders' Gazette, vol. lx, p. 82. Chicago, 1911.
[12] Ewart, J. Cossar, Address to Zoological Section, British Association, 1901; quoted by Reid, G. Archdall. The Principles of Heredity, p. 69. New York, 1905.
[13] *Ibid.*
[14] Cited by Davenport, E. Principles of Breeding, p. 568. Boston, 1907.
[15] This is the idea developed by C. L. Redfield in Dynamic Heredity (New York, 1915) and elsewhere.
[16] The Pennycuik Experiments, p. 44.

others (and this whether the prepotency has been acquired through inbreeding or as a 'sport'), or prepotent with one mate and not with another, or prepotent one year and not the next; because prepotency is of necessity subject to the influence of variation and reversion, and also doubtless of nutrition—more especially of the germ-plasm prior to fertilization."

THE COMMERCIAL ELEMENT

When a term has so many and so varied explanations, it might seem impossible to comprehend them all in any one definition. But if we view the question solely from the standpoint of the stock-breeder, I think we will find that these definitions really are summed up in one idea. To him, prepotency is less a genetic than a commercial question: the prepotent sire is the one that produces a large proportion of offspring of high market value because of their possession in an eminent degree of the valuable commercial characters of the breed.[17]

From a genetic point of view, unfortunately, we can not reduce this complexity to simplicity, as we have done from the practical breeder's point of view by assuming that it is, in the last analysis, merely a matter of dollars and cents.

If we analyze "prepotency" from the standpoint of the geneticist, rather than that of the breeder, we find that it may appear in a number of ways, and that of two animals, one may be the more prepotent in one respect, the other in another. Its prepotency may be shown by

1. Greater influence on the mean grade of the offspring.
2. Greater uniformity in offspring.
3. Greater influence (1 or 2) on second and later generations.
4. Influence (1, 2, or 3) in greater variety of crosses.
5. Influence (1, 2, 3, or 4) in greater number of characters.

Facing such a situation, I think geneticists might well avoid the use of the term "prepotency" and employ more definite words to express more circumscribed ideas. But I do not think this need deprive live-stock breeders of the use of the term, as some geneticists would insist. After all, the word is the property of animal breeders, who use it to cover a fairly definite result, although a result that may be reached in various ways and capable of various explanations.

My position in regard to prepotency, in short, is that it is a descriptive term belonging to practical breeders, not to geneticists. It is used by breeders in a way that they understand and find useful. The geneticist should not try to interfere with this use unless he can substitute something better; and at present I do not think he can.

THE MENDELIAN EXPLANATION

What he offers is, in general, the idea of dominance of Mendelian characters, to replace the idea of dominance (prepotency) of an individual.[19] There is room for a good deal of discussion on this point, and I shall not take time here to discuss it. What the breeder wants is prepotent animals, and what he wants the geneticist to tell him, is how he shall proceed to get them.

I mentioned, in the note on Brigham Young, three possible methods: (1) consanguineous marriage; (2) assortative mating; (3) chance. The live-stock breeder might term these (1) inbreeding, (2) pure-breeding, (3) haphazard breeding or random mating.

Of these, the first is considered by general recognition among intelligent students of breeding, to be the quick and effective way of securing prepotent animals. No student of pedigrees can doubt that inbreeding does result in prepotency.

[17] This suggestion was made by Dr. Sewall Wright of the Bureau of Animal Industry, at the conference mentioned by Mr. Rommel. To Dr. Wright I also owe the five-fold division of the subject from a genetic point of view, which is given a few paragraphs later.

[18] Hover, J. M. Finding the Prepotent Sire. Journal of Heredity, vii, No. 4, pp. 173–178, April, 1916.

[19] See *e. g.*, Wentworth, E. N. Prepotency. Journal of Heredity, vi, No. 1, pp. 17–20, January, 1915.

Starting from this observed fact, it is very easy to frame a hypothetical explanation of why inbreeding and pure-breeding produce prepotency. Most geneticists would probably agree on it.

The explanation which fits the facts is this: that prepotency is due to the presence of a number of *homozygous* factors for the valuable characters of the breed.[20] Ordinarily these factors will have to be dominant, but it is not difficult to think of cases where prepotency, within a single herd, say, might be due to the possession of homozygous recessive factors.

Inbreeding will make factors homozygous, if they were not so to start with. So will pure breeding, the mating of like with like, accompanied by selection, as it usually is. It is therefore easy for a Mendelist to see why a purebred animal is ordinarily prepotent over a scrub.

Further, although the breeder is selecting for only a few characters, and rendering these homozygous by appropriate mating and selection, he is automatically, at the same time, making other characters homozygous. Making a breed homozygous (*i.e.*, prepotent) in one dominant character will tend to make it homozygous (*i.e.*, prepotent) in all dominant characters. Thus the appearance of "individual prepotency" will be increased.

I do not say that this is the explanation of prepotency, but it is at least an explanation which, so far as I can see, brings the observed facts in harmony with Mendelian results.[21]

Whatever be the origin of prepotency, from a genetic point of view, the experience of breeders leaves little doubt as to the best course to follow, in the light of our present knowledge, if one wishes to secure that commercially valuable result known as prepotency. It may be expected from the mating of the best animals, selected to the same standard (*i.e.*, pure-bred) or better still, related by blood; and by selection in each generation of the animals that have the desired character in the highest degree.

The prepotency thus obtained is a measurable fact. It can be explained by a Mendelian hypothesis which makes it a matter of homozygous, dominant characters; but such an hypothesis is, in respect to the valuable traits of farm animals, still unproved and I do not think we are in a position to say whether or not it covers the whole ground. And until the geneticists have supplied the necessary proof, practical breeders will continue to talk about prepotent individuals, when they refer to individuals that are prepotent in a certain number of commercially valuable characters.

[20] Since we are dealing with hypotheses, I add that this condition should be accompanied by a minimum number of necessary complementary factors and a maximum number of duplicate factors; and, as Wentworth suggests, linkage may also be involved.

[21] It is quite possible that the breeders are right in claiming that inherited vigor plays a part in prepotency. If so, this would make a very near approach to that "individual prepotency" which some of the geneticists think impossible. Until proof is forthcoming, it would be well to keep an open mind and not say that there is no such thing as individual or general prepotency, even though many supposed cases of it are shown to be merely cases of character prepotency.

The

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STORY HOUR AT THE MOTHERCRAFT SCHOOL

There are two ways of training girls for motherhood: one is to put them in a class-room, with a text-book, and lecture at them; the other is to let them actually care for children of various ages, under careful supervision. The former method is that generally adopted nowadays, but the latter method, the only psychologically sound one, is that championed by the Mothercraft movement. (Frontispiece.)

MOTHERCRAFT

An Attempt to Make the Education of Girls Fit Their Requirements—Work Done in Private Schools—Should be a Part of the Public Schools—An Important and Immediately Practicable Phase of Constructive Eugenics

Mary L. Read

Educational Director, National Association for Mothercraft Education, New York, N. Y.

From Pennsylvania a young woman writes me:

> "I am one of many girls whose training has fitted them for almost any position except the one of wife and mother. Since my marriage almost two years ago I have struggled daily to run the house economically and make up the deficiency in my early education. Now that the baby is coming I am facing a job for which I am even less prepared than for the other, and when I think that our baby's life may pay the forfeit for the mistakes I make in this direction, I am afraid of the future. Where can I find anything that will help me to learn how to take care of myself now and of the baby later? I shall be very grateful to you for anything you can give me."

The letter is only one of very many that I have received. What proportion of the young women in the educated and well-to-do class would express similar sentiments, if they were questioned? I venture to estimate somewhere near a majority.

The girls themselves are not to blame for this state of affairs; but someone is to blame.

It is one of the riddles of history why, when the life and welfare of children are of such vital concern to the family and the race, society has never taken the trouble to see to it that the women in whose charge these precious baby lives rested were highly trained and fittingly prepared for their responsibilities. Some people have even said it was not "nice" for young girls to think they would ever be mothers (although they knew they would and so did everyone else)—therefore it was not proper for them to be told about how to care for babies. Sometimes they were instructed in other housewifely arts; but when it came to the care of the child, the young mother usually has had to gain her experience at the expense of her own baby.

We are now beginning to see that such a state of affairs is criminal, and that the young girl needs education in what I have called Mothercraft, above everything else.

But I would emphasize at the outset that Mothercraft should be conceived as a much larger matter than merely instruction as to how one should treat a baby when it cries. It should include as much as possible of the knowledge essential to founding a family and carrying it along successfully. As a beginning, it should teach the girl a good deal about the qualities she should possess and that she should seek in the man she marries.

How unromantic! you say.

Not at all. There is no essential contradiction between romantic love and eugenics. A young woman knows a hundred young men, but is in love with only one (or possibly none) because the others do not embody the ideal that she has fashioned. Every young woman (and the same is true of men) has such an ideal, perhaps only vaguely defined but certainly felt, with which she is in love, for which she searches, and with which she sometimes invests an acquaintance only to discover later her illusion. This ideal is composed of the most alluring qualities and personalities she has known or read about.

EUGENICS AND LOVE

What normal young man would be likely to fall in love with a girl, however pretty, even charming, who he knew could be the mother only of

sickly, peevish, stupid children to inherit his name and perpetuate his family, or who would refuse to assume the burden of motherhood? What normal young woman would be attracted by any "fairy prince," however romantic, wealthy, handsome, if she were aware that his children would be doomed to early death, weakness or imbecility, and that she herself would be made a sufferer for life? The widespread tendency of young men and women of the present day to include eugenic qualities in this romantic ideal is itself sufficient evidence. Young men and women are generally too well balanced to marry simply from eugenic consideration without romantic love, although this is less reprehensible than marriage simply for title, livelihood, for social distinction, for personal creature comfort without consideration for either eugenics or romantic love.

It was with the most comprehensive idea of what such an education might possibly include, and the coining of a word which I hoped might define it to others, that I founded in New York City, in 1911, the School of Mothercraft. From the outset, the work was arranged for young women of at least high school education, and some of the students have been graduates of colleges or boarding schools.

The pedagogical principles on which I proceeded were those of my former teachers, John Dewey and G. Stanley Hall. Students must "learn to do by doing." Some visitors once expressed surprise and some disappointment because they said they had come expecting to see a school but what they found was a home. I considered this one of the greatest tributes they could have given the work. The school has always been conducted in a private residence, with resident students and a little group of resident children, ranging in age from a few months to seven years. Besides the resident students, many day students have come for special classes. The home conditions and spirit are carefully maintained.

In addition to their classes and recitations, students have several hours each day of practical work in the household and with the children. They learn their cooking by assisting in the preparation of meals and the cooking for the children. They learn how to do all the phases of household work by assisting the housekeeper, who is also the home economics teacher. Much attention is given to learning how to economize time and energy in doing the housework. The family budget is studied and they find out how to make the best use of a family income of \$1,200 a year, with discussions, as well, of incomes down to \$800 and up to \$3,000 a year. They go to the shops and learn how to buy household furnishings and linens, and the clothing for little children. They learn how to market, going with the instructor to do the week's provisioning. One of the practical problems which they reach by the midyear is buying the food for the family, and providing a balanced diet, in variety of appetizing food, at \$2.50 a week per person.

WORK WITH CHILDREN

But the most unique work is that with the children. At first the students simply live and play with the children, as members of the household, learning how to be with children and not do them harm—a lesson which few adults have ever learned. They observe the nursery "mother" as she cares for the physical needs of the children, and they participate in the group play with the kindergarten teacher. By degrees, as they learn the principles of child hygiene and psychology, they have practical experience, still under the supervision of instructors, in the daily physical care of the children at each age (including the baby), in story-telling, nursery games and songs, kindergarten handwork, nature-study. They learn how to take the important physical measurements of the children, the physical inspections that a nurse or physical education director would make, and how to study the disposition, mental traits and character of children.

Some of the students are preparing for their own home-making. Others are preparing for social work in settlements, day nurseries, orphanages, as

superintendents, investigators or teachers. These have special opportunity for observing all phases of social work in New York City and for acquiring practical experience in connection with some of the local institutions or societies.

Other students are preparing for the vocation of mothers' assistants or nursery governesses. This is a new vocational opening for educated young women in this country. Many parents now realize that a crude or immature girl, untrained and without either experience or judgment, is not a fit person to place in charge of a baby, or a little child at its most impressionable period in life. There is a large demand for trained mothers' assistants who are women of personality and education, but for lack of a training school few women have been prepared to fill these positions. The students preparing for this vocation have experience as part-time assistants, going by the day or the week to private families until they have had a wide range of such experience.

Before a student receives her certificate she must have demonstrated by actual work in the school that she can manage the household with efficiency, patience and economy; do any phase of the household work and put system and economy into that work; take the care of the baby or any of the children; make a personal study of a child and outline the program for its personal care and mental development; conduct the play and daily natural discipline of little children under home conditions; she must have accumulated a fund of child lore—rhymes and songs, plays, handwork, and stories that have been carefully selected for their fitness and educational value as well as their interest to little children.

To an outsider the curriculum of a mothercraft school suggests a selecting from the courses given in a number of different professional schools—kindergarten, home economics, physical education, nursing—brought together and taught in a home, from the home point of view.

Although there are still very few places in the United States where a young woman can get practical instruction in Mothercraft, yet parts of the work are being taken up by various agencies. Some of the State universities and some of the expensive and fashionable boarding schools are devoting special attention to home-making. Most girls' schools now offer some domestic science, but in most cases it is very brief, chiefly of a laboratory type, concerned with household mechanics, not concerned with practical or eugenic aspects. The hundred or more Little Mothers' Leagues in the New York City public schools are doing something in infant care for younger girls. There are a number of hospitals over the country where nursery maids are trained. Mothercraft is opposed to the training of crude nursery maids. Even the idea of training intelligent mothers' assistants is quite secondary to that of the training of future mothers. Such vocational training of educated young women is being done more widely in England and Germany than in the United States, many of the day nurseries abroad having educational departments.

Education in Mothercraft, however, is not a subject that should be left to private schools; it is an essential part of public education, and many prominent educational authorities have recognized this fact in principle, though school boards and trustees with the traditional ultra-conservatism of educational systems, are slow to put the idea into practice.

With a view to furthering the wider acceptance *and adoption* of this principle the National Association for Mothercraft Education is being formed, with headquarters in New York City. Its objects specifically are:

(*a*) To maintain a School of Mothercraft in or near New York City, providing for resident and non-resident students, extension classes, visiting instruction; having a kindergarten, resident nursery, public reference library.

(*b*) To develop branch schools of Mothercraft throughout the United States; and to conduct extension classes and institutes.

(*c*) To encourage similar education in homes, societies, schools and colleges.

(*d*) To hold conferences of its members and others interested.

(*e*) To educate public opinion by circulating literature, by meetings, by exhibits.

(*f*) To cooperate with institutions, organizations and individuals working toward the same general purpose.

Eugenicists have expressed hearty sympathy with the idea of Mothercraft education, appreciating that it is in large part a genuinely eugenic movement, and not a mere matter of euthenics; that it antedates and goes deeper than some phases of the "Save the Babies" movement, which in some quarters even disregards the interests of eugenics. Let us quote some of Galton's own words:

"Man is gifted with pity and other kindly feelings; he has also the power of preventing many kinds of suffering. I can conceive it to be within his power to replace Natural Selection by other processes that are more merciful and not less effective. This is precisely the aim of eugenics. Its first object is to check the birth rate of the unfit, instead of allowing them to come into being, though doomed in large numbers to perish prematurely. The second object is the improvement of the race by furthering the productivity of the most fit by early marriages and healthful rearing of their children. Natural Selection rests upon excessive production and wholesale destruction; eugenics in bringing into the world no more individuals than can be properly cared for and those only of the best stock."

Galton considered as a worthy eugenic measure the providing of a dowry for worthy young women, who in England in his day had limited prospects of marriage without such accessory. In our day and country this has no meaning. It is the adolescent girl, who in our country has almost unlimited freedom of choice as to whom she will marry—or whether she will marry at all—who holds the control of the future of the family and the race. It is she who controls the birth rate, infant mortality, the divorce rate, monogamy, polygamy or promiscuity, social welfare. According to her ideals, her foresight, her wise direction of instincts will society progress or deteriorate at its very foundations. Shall she be left to meet these responsibilities with only the guidance of impulse and naïvete, with the impression that to anticipate them seriously is unbecoming and abnormal? Naturally, she is not interested in technical essays, charts, diagrams, research reports, controversial discussions in genetics and social psychology and pathology. She will rarely appreciate her responsibilities through such channels until after her important decisions have been made—if ever. But there is for her a direct avenue. She instinctively loves little children and loves to be with them. Mothercraft education, with its intimate daily life with little children, is teaching eugenics in a language she can understand. From her training in the care and education of these little tots she eagerly comes with personal questions of eugenic import; she begins to realize that it is natural and normal for her to anticipate this phase of her future and to prepare herself for it; and she seriously develops her ideals for her own family.

Mothercraft education is constructive eugenics, based upon the maternal instinct inherent in every girl, pedagogically utilizing the nurturing, play, work and childlife interests of young womanhood. Truly, for these young women it is not learned theses, but a little child that shall lead them.

Infant Mortality Meeting

The next meeting of the American Association for the Study and Prevention of Infant Mortality will be held in Milwaukee, Wisconsin, October 19–21, 1916.

The section on Eugenics will hold no meeting. Prof. M. F. Guyer, of the University of Wisconsin, who is now chairman of the eugenics committee, is arranging a meeting for 1917.

CONSANGUINEOUS MARRIAGE

Subject Often Regarded by Unscientific Methods of Thought and Effects Misunderstood—Consanguinity in Itself Probably Has no Genetic Importance—The Hereditary Traits Are the Things To Be Considered—Marriage of Kin May Be Either Good or Bad in Effect

The Editor

HOW often have we been told of those "isolated communities where consanguineous marriage has led to an appalling amount of defect and degeneracy!" Any one of us could name a dozen of these "horrible examples" offhand. Without questioning the facts, one may question the interpretation of the facts, and it seems to me that a wrong interpretation of such stories is partly responsible for the widespread and almost superstitious misunderstanding of consanguineous marriage at the present time.

The Bahama Islands furnish one of the stock cases, and Dr. W. C. Rucker has just put in my hands a copy of Dr. Clement A. Penrose's account of the situation there.[1] What the traveler says has a very familiar sound:

"In some of the white colonies where black blood has been excluded, and where, owing to their isolated positions, frequent intermarriage has taken place, as for instance at Spanish Wells, and Hopetown, much degeneracy is present, manifested by many abnormalities of mind and body. . . . I am strongly of the opinion that the deplorable state of degeneracy which we observed at Hopetown has been in a great measure, if not entirely, brought about by too close intermarrying of the inhabitants," and so on.

To demonstrate his point, he took the pains to compile a family tree of the most degenerate strains at Hopetown. There are fifty-five marriages represented, and the chart is overlaid with twenty-three red lines, each of which is said to represent an intermarriage. This looked like a good deal of consanguineous mating, but I thought I would test the matter a little further, so I started with the fraternity at the bottom of the chart—eight children, of whom five were idiots—and traced out their ancestry. In the second generation it ran to another island, and when the data gave out, at the fourth generation, I was a little surprised to find that there was not a single case of consanguineous marriage involved.

I picked out another fraternity consisting of two men, both idiots and congenitally blind, and a woman who had married and given birth to ten normal children. In the fourth generation this pedigree, which was far from complete, went out of the islands; as far as the data showed there was not a single case of consanguineous marriage. There was one case where a name was repeated, but the author had failed to mark this as a case of intermarriage, if it really was such. If we assume that it was a first-cousin marriage, yet almost any one of us may have one first-cousin marriage in the preceding four generations of his pedigree. I am unable to share the conviction of Dr. Penrose, that in the two pedigrees which I investigated, we have an example of the nefarious workings of intermarriage.

CONGENITAL BLINDNESS

Finally, I traced out a fraternity to which the author had called particular attention because three of its eleven members were born blind. The defect was described as "optic atrophy asso-

[1] Penrose, Clement A., "Sanitary Conditions in the Bahama Islands." Geographical Society of Baltimore, 1905.

ciated with a pigmentary retinitis and chorydítis" and "this condition," Dr. Penrose assured us, "is one stated by the authorities to be due to the effects of consanguineous marriage."

Fortunately, the pedigree was fairly full and I was able to carry several lines of it through the sixth generation. There was, indeed, a considerable amount of consanguineous marriage involved. When I came to measure the amount of inbreeding represented by these blind boys, I was struck by the fact that it is almost identical with the amount represented by the present Kaiser of Germany.[2]

The coincidence seems to me eloquent.

I am unable to see in such a history as that of Hopetown, Bahama Islands, any evidence that consanguineous marriage necessarily results in degeneracy. It seems to me that Dr. Penrose himself points to a potent factor when he says of his chart, in another connection: "It will be noticed that only a few of the descendants of Widow Malone (the first settler at Hopetown) are indicated as having married. By this it is not meant that the others did not marry; many of them did, but they moved away and settled elsewhere, and in no way affected the future history of the settlement of Hopetown."

I have an idea that, by moving away, they did very decidedly affect the future history of Hopetown. Who are the emigrants? In most cases, probably the more enterprising and intelligent, the physically and mentally superior of the population, who rebelled at the limited opportunities of their little village, and went to seek a fortune in some broader field. The best went; the misfits, the defectives, stayed behind to propagate. Emigration in such a case has the same effect as war; it drains off the best stock and leaves the weaklings to stay home and propagate their kind. Under such conditions, defectives are bound to multiply, regardless of whether the marriages are consanguineous.

"It will be seen at a glance," Dr. Penrose writes, "that early in the history of the Malone family these indications of degeneracy were absent; but they began in the fourth generation and rapidly increased afterward until they culminated by the presence of five idiots in one family. The original stock was apparently excellent, but the present state of the descendants is deplorable."

Now three generations of emigration from a little community which even today has only 1,000 inhabitants, would naturally make quite a difference in the average quality of the population, eugenically speaking. In almost any population, a few defectives are constantly being produced. Take out the better individuals, and leave these defectives to multiply, and the amount of degeneracy in the population will increase, regardless of whether the defectives are marrying their cousins, or unrelated persons. The family of five idiots, cited by Penrose, is an excellent illustration, for it is *not* the result of consanguineous marriage—at least, not in a close enough degree to have appeared on the chart. It *is* doubtless a mating of like with like; and biologically that is all that consanguineous marriage is. Only, if two people are related by blood, they are more likely to carry the same hereditary traits than are two strangers. This is by no means always the case: if two inmates of an institution for the deaf, or the feeble-minded, or the epileptic, marry (they are doing it frequently, in most parts of the United States) it is perfectly obvious that they probably have the same inherited defect; while the chance that children with one of these defects would result from the marriages of first cousins, in whose family the defect was not previously known, is practically *nil*.

Honesty demands, therefore, that consanguineous marriage be not credited with results for which the consanguineous element is in no wise responsible; and the prevailing habit of picking out a community or a strain where consanguineous marriage and defects are *associated* and loudly declaring the one to be the *cause* of the other, is a perni-

[2] See von Gruber and Rüdin, Fortpflanzung, Vererbung, Rassenhygiene, p. 169. München, 1911.

cious evidence of the lack of scientific thought that exists almost everywhere.

Most of the studies of these isolated communities where intermarriage has taken place, illustrate the same point. Davenport, for example, quotes[3] an anonymous correspondent from the island of Bermuda which "shows the usual consequence of island life." He writes: "In some of the parishes (Somerset and Paget chiefly) there has been much intermarriage, not only with cousins but with double first cousins in several cases. Intermarriage has chiefly caused weakness of character leading to drink, not lack of brains or a certain amount of physical strength, but a very inert and lazy disposition."

It is difficult to believe that anyone who has lived in the tropics could have written this, except as a practical joke. Those of us who have lived in the warmer parts of the world know by observation if not by experience, that a "weakness of character leading to drink" and "an inert and lazy disposition" are by no means the prerogatives of the inbred. And in connection with the latter part of the indictment, the hookworm should not be forgotten.

If we are going to credit consanguineous marriage with these evil results, what are we going to do when evil results fail to follow?

What about Smith's Island, off the coast of Maryland, where all the inhabitants are said to be interrelated, and where a physician who lived in the community for three years failed to find among the 700 persons a single case of idiocy, insanity, epilepsy or congenital deafness?

What about the community of Batz, on the coast of France, where Voisin found five marriages of first cousins and thirty-one of second cousins, without a single case of mental defect, congenital deafness, albinism, retinitis pigmentosa or malformation? The population was 3,000, all of whom were said to be interrelated.

What about Cape Cod, whose natives are known throughout New England for their ability? "At a recent visit to the Congregational Sunday-School," says a student, "I noticed all officers, many teachers, organist, ex-superintendent, and pastor's wife all Dyers. A lady at Truro united in herself four quarters Dyer, father, mother and both grandmothers Dyers."

EXPERIENCE OF BREEDERS

And finally, what about the experience of livestock breeders? Not only has strict brother and sister mating—the closest inbreeding possible—been carried on for twenty or twenty-five generations, experimentally, without bad results, and even with good results; but the history of practically every breed shows that inbreeding is largely responsible for its excellence.

Dr. Penrose adopts a common attitude toward these facts. "I cannot conclude from them that close and continued intermarriage among human beings is unattended with evil results," he informs us, "for we can never be certain that the same conditions are followed in the reproduction of the human species as are enforced in the breeding of animals. The organization of the human being is so complex, and the nervous system so delicately balanced, that it is difficult, if not absolutely impossible, to establish a human type, and to agree as to what constitutes good human stock. Nothing is more difficult than to find a perfectly normal man or woman, and if we cannot agree as to what constitutes a normal type, how are we to decide as to what constitutes an abnormality? In a sense, a genius is as abnormal on one hand as an idiot on the other, and it is impossible to draw a line between a being with normal mental capacity and one which is slightly below the standard."

What does all that mean, in connection with the marriage of kin? Precisely nothing.

Consanguineous marriage will doubtless continue, for many years, to exist in a fog of superstition, but the time is past, it seems to me, when any one can question the facts from the genetic point of view. If we know anything

[3] Davenport, Charles B., "Heredity in Relation to Eugenics," pp. 184 ff. New York, 1911.

about heredity, we know that consanguineous marriage, being the mating of like with like, intensifies the inheritance of the offspring, which gets a "double dose" of any trait which both parents have in common. If the traits are good, it will be an advantage to the offspring to have a double dose of them; if the traits are bad, it will be a disadvantage. The marriage of superior kin should produce children better than the parents; the marriage of inferior kin should produce children even worse than their parents.

In passing judgment on a proposed match, therefore, the question to be asked is not, "Are they related by blood?", but "Are they carriers of desirable traits?" That is, perhaps, a rather cold-blooded way to put it, but once in a while, at least, a marriage *is* regarded in a cold-blooded, genetic light, as the number of letters to me, asking advice about consanguineous marriage, abundantly proves.

The nature of the traits can be told only by a study of the ancestry. Of course, characters may be latent or recessive for many generations, but this is also the case in the population at large, where the chance of unpleasant results is so small that it would be foolish to weigh it. If the same congenital defect or undesirable trait does not appear in the previous three generations (including collaterals) of two cousins I know of nothing in genetics which would discourage them from marrying if they want to.

The Inheritance of Emotional Control

THE DACK FAMILY, a Study in Hereditary Lack of Emotional Control. By Mrs. Anna Wendt Finlayson, Field Worker of Warren State Hospital, Warren, Pa. Preface by Charles B. Davenport. Eugenics Record Office, Bulletin No. 15. Pp. 46, price 15 cents. Cold Spring Harbor, Long Island, N. Y., May, 1916.

This study of several hundred related individuals, covering three generations, in the mountains of Pennsylvania, describes another large group of socially worthless people, the descendants of two Irish immigrants. The stock is characterized by "restlessness, quarrelsomeness, loquacity, abuse, pugnacity, intermittent outbursts of violent temper, and sex offense," as well as laziness, mental dullness, alcoholism, and the other usual marks of a degenerate strain. The preface tells us that "the present study is of especial value since it illustrates again the fact that the aberrant behavior of each family group is stamped with its peculiar characteristics; because into each a unique combination of hereditary elements has entered." This may be true, but the present study offers no proof, since no systematic attempt is made to allow for the influence of the environment, and no adequate evidence is offered that the various emotional traits described are in reality due to inheritance. But although the study may add nothing to our knowledge of heredity, it is useful sociologically as picturing a kind of family stock which is costly to the race, and unfortunately all too numerous in some parts of the United States.

Eugenics Education in St. Louis

The St. Louis Eugenics Educational Society now has nearly two score members, according to a letter from the secretary, C. R. Paine. The scope of the organization is much broader than the term "eugenics" ordinarily includes, embracing as much environmental influence as inheritance. "We feel," Mr. Paine writes, "that the present eugenic thought is not only very academic but quite chaotic in its ordering; not having as yet found a clear base-line for thinking, systemizing and methodizing. Consequently the present thought is very impersonal; seeking more after negative factors than positive ones; more after heredity than environmental-social influences; law than education in its broad popular sense; statistics than life."

INHERITANCE OF BALDNESS

Various Patterns Due to Heredity and Sometimes Present at Birth—A Sex-limited Character—Dominant in Man—Women Not Bald Unless They Inherit Tendency from Both Parents[1]

Dorothy Osborn

Ohio State University, Columbus, Ohio

THERE are several distinct patterns of baldness. They vary in extent from the small spot, not uncommon, to entire baldness which is exceptional. Among the most common patterns are complete baldness on the top of the head, that involving only the crown, that giving the appearance of an extremely high forehead, and that covering the top and back of the head. The hair associated with baldness may be thin, normal or heavy.

Many theories have been advanced as to the cause of baldness. Some of these are diseases of the scalp, ill health, pressure of tight hatbands on the scalp, and heredity. Recently an article appeared in a popular magazine declaring that baldness is entirely due to the indiscriminate wearing of hats, not necessarily tight. Not baldness itself, but the shape of the head is inherited and in wearing hats the consequent pressure on the blood vessels nourishing the scalp causes the loss of hair. The main argument in support of this theory was that women never become bald.

In collecting data for this paper all types of hair were recorded as thin, normal or heavy. Questions were also asked as to how long heavy hair was retained, the pattern and time of appearance of baldness if present, the kind of hat worn, and what was used to prevent baldness. The results show that baldness is undoubtedly hereditary.

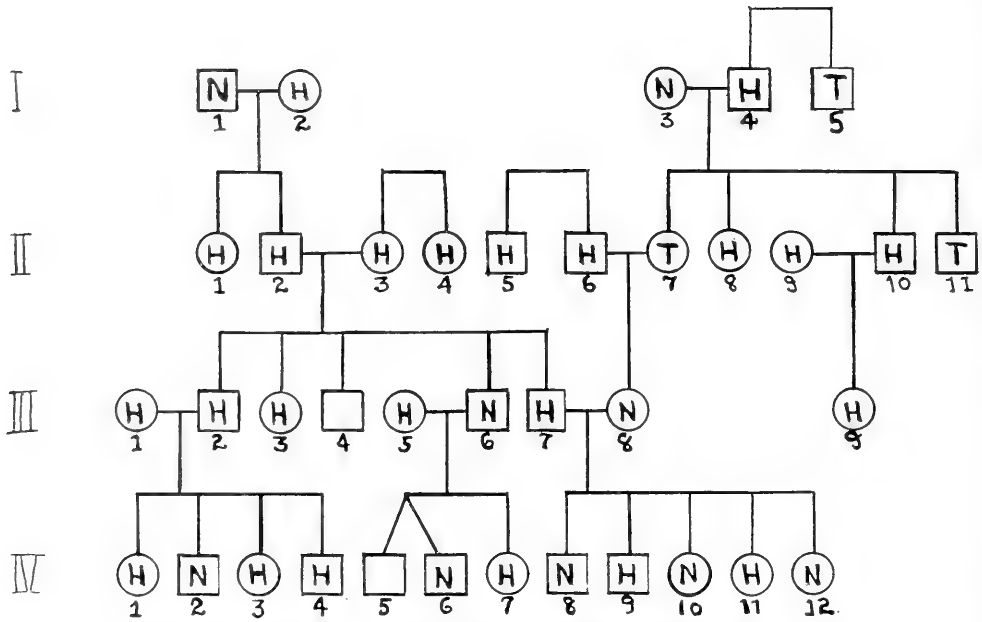
Two families with exceptionally heavy hair were traced, and no baldness could be found in either one. Ordinary tight hats had been worn by the men, which had not affected the persistence of the hair. In case the hair was exceptionally heavy in youth more than a normal amount was retained to an advanced age.

NO BALDNESS HERE

A head of thick, fine hair, at the age of 33. Father of this subject is now 61 years old with abundant hair. Both father and son wear tight hats. There is no baldness in the family history. (Fig. 1.)

In the first chart, III 3 had very poor health, but until her death at thirty-five her hair was always remarkably heavy. Ill health had had no noticeable effect. Her niece, IV 12, now twenty years old, who originally

[1] Contribution No. 48 from the Department of Zoology and Entomology, O. S. U. This work was done in a course in genetics under the direction of Prof. William M. Barrows.



A FAMILY IN WHICH NO BALDNESS HAS APPEARED (Chart 1)

Squares represent males and circles females; solid black symbols (used in subsequent charts, but not in this one) indicate baldness. H=heavy hair, N=a normal amount, T=thin hair, ? indicates uncertainty as to baldness, due to lack of information. Particulars as to the individuals on the above chart follow:

Generation I. I 1 had at least a normal amount of hair, and it may have been heavy. I 2 had heavy hair, and many members of her family had exceptionally heavy hair. I 3 had at least a normal amount of hair, and I 4 probably heavy. I 5 had thin hair.

Generation II. II 1, II 2, II 3, II 4, II 5, and II 6 had heavy hair, and retained same throughout life. II 7 has thin hair, is now eighty-nine, and retains her normal amount of hair. II 8, II 9, and II 10 had heavy hair. II 11 had thin hair.

Generation III. III 1 had heavy hair. III 2 has very heavy hair. III 2 had very heavy hair, and although in poor health for a number of years, retained it until her death at thirty-five. III 4 died at the age of thirteen which makes data doubtful. III 5 and III 6 both have heavy hair. III 7 has exceptionally heavy hair and retains same at sixty years of age. III 8 has about normal hair. III 9 had heavy hair.

Generation IV. IV 1, IV 3, and IV 4 have very heavy hair. IV 2 has not much more than a normal amount. IV 5 died in infancy. IV 6 has not much more than a normal amount. IV 7 has exceptionally heavy hair. IV 8 has about the normal amount. IV 9 has extremely heavy hair, very similar to his father's. IV 10 has slightly less than normal. IV 11 has very heavy hair, and IV 12 has less than a normal amount, due to illness. (Fig. 2.)

had a normal amount of hair, has lost much through poor health. In the other family studied, one man, now sixty, has been in very poor health for a number of years, but there has been no noticeable effect on his hair, which is very heavy and coarse.

Returning to chart 1, II 7 and I 5 both had very thin fine hair, but retained it until very late in life. I 5 died at ninety-three and II 7 is now eighty-nine. Her husband, II 6, had heavy coarse hair and their daughter, III 8, has a normal amount of moderately fine hair. The husband of III 8, now sixty, has exceptionally heavy coarse hair, common in his family. The children of this mating show an interesting variety of amounts and textures of hair. IV 8 has a normal amount of moderately fine hair; IV 9 has exceptionally heavy, coarse hair like his father's; IV 10 has not quite a normal amount of moderately coarse hair; IV 11 has very heavy, fine hair, and IV 12 has rather thin fine hair.

TWO CASES OF PATTERN-BALDNESS

The same individuals are shown in each picture. The man at the right (upper, in the second picture) had heavy, coarse, curly hair until twenty years ago, when he began to lose it very gradually. His father had the same pattern of baldness; his mother's family had thin hair but no baldness. The lower individual has thin, straight hair; baldness appeared at the age of 19, and his son developed the same pattern at the same age. The maternal grandmother of the man here shown was bald. (Fig. 3.)

From the two families traced definite conclusions cannot be drawn as to the inheritance of the amount of hair. Number of individual hairs and textures are probably inherited separately, the appearance of amount being dependant on both.

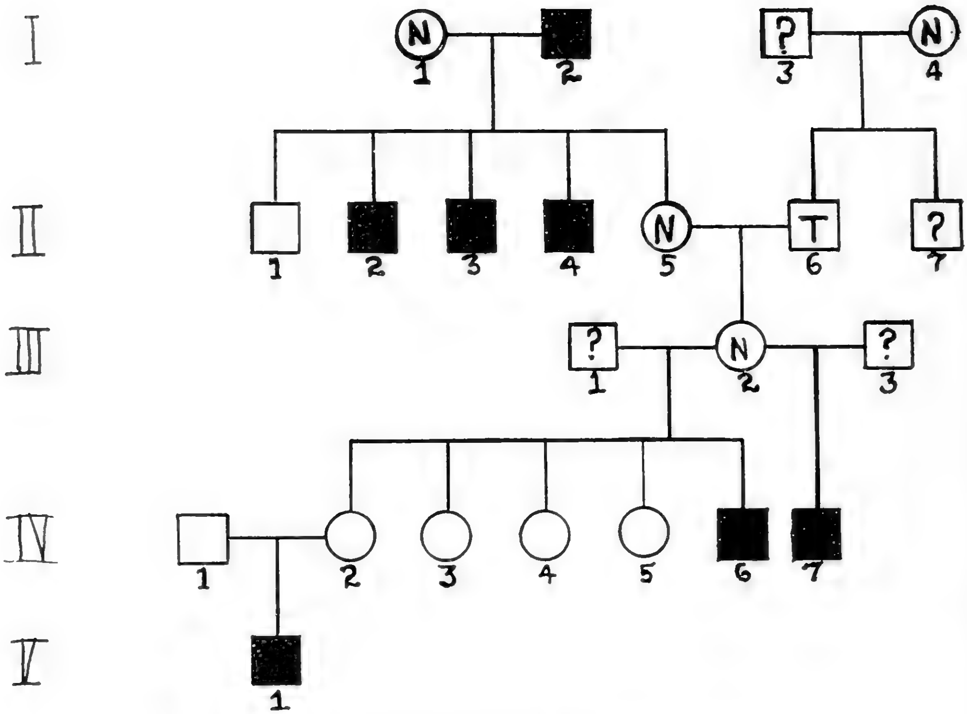
The families which were traced in reference to baldness show that it is inherited as a sex-limited trait. It is dominant in men, is inherited directly from father or mother to son, but is recessive in women. Apparently a duplex condition in women is necessary to bring it out. This is the same condition that Thos. R. Arkell found in the inheritance of horns in sheep.[2]

Partial baldness sometimes occurs in women in case there is illness in addition to a simplex inheritance. Where there is not the tendency to baldness the hair is slightly affected by poor health and sometimes falls out, but is regained upon the recovery of good health. Moreover, as has already been stated, some individuals in very poor health do not lose any hair.

In one family, unfortunately not charted, the father became very bald before he was thirty. His only son showed the exact pattern of his father's baldness at birth. The only hair on the head was in a fringe above the ears and at the back. Later hair came in on the top of the head, presenting a normal appearance. The boy is now nineteen years old and is beginning to lose hair above the forehead. This seems to indicate that the pattern is present at birth.

Congenital baldness must not be confused with pattern baldness. In the former there is no hair whatever, eyebrows are lacking and nails are poor or faulty. Instead of hair there is sometimes a downy fuzz. One family observed has shown this trait for the three generations about which anything is definitely known. The grandfather, father and mother were completely bald from birth. The seven sons and one daughter have never had any hair. The only grandchild, son of the oldest boy, also shows the same peculiar trait

[2] Arkell, T. R. "Some Data on the Inheritance of Horns in Sheep." New Hampshire Agricultural Experiment Station, Bull. 160, May, 1912.



BALDNESS PASSED THROUGH WOMEN (Chart 2)

Symbols the same as in the preceding chart.

Generation I. I 1 had a normal amount of hair. I 2 was very bald but at what age is unknown. I 3 is questionable. I 4 had a normal amount.

Generation II. II 1 was not bald but amount of hair is unknown. II 2, II 3 and II 4 were all very bald but age of appearance is unknown. II 5 had a normal amount of hair. II 6 had thin hair. II 7 is questionable.

Generation III. III 1 is questionable. II 2 had a normal amount of hair but was undoubtedly a carrier, inheriting the trait from her mother who was also a carrier. III 3 is questionable.

Generation IV. IV 1 never became bald and had at least a normal amount of hair. IV 2 now past middle age, is a carrier but has never shown the trait herself. Her sisters, IV 3, IV 4 and IV 5, have never shown any signs of baldness. IV 6 was very bald. IV 7, a half brother, was also very bald.

Generation V. V 1 became very bald between the ages of twenty-five and thirty. (Fig. 4.)

of his father's family. In all of these cases the nails were abnormal.

Charts 2, 3, 4 and 5 illustrate clearly the general laws of the inheritance of pattern baldness. Chart 2 is presented to show that in case a woman inherits the simplex condition she does not become bald herself, but transmits baldness, in the long run, to one-half of her sons and also the possibility of transmission to one-half of her daughters. A bald man with a simplex inheritance transmits in the same way. I 1 had a normal amount of hair, but may have been a carrier. I 2 was bald. Three out of four sons of this mating, II 2, II 3, and II 4, were all bald, and the only daughter, II 5, was probably a carrier. Her husband, II 6, was never bald. The daughter of this couple, III 2, inherited the trait from her mother and transmitted it to two sons, IV 6 and IV 7, and, at least, one daughter, IV 2. She was married twice but as nothing is known in reference to the hair of either husband, and moreover, as a son by each marriage was bald, it was concluded that the trait was inherited through her. IV 1 was never bald, so could not transmit baldness. IV 2 must be a carrier, transmitting the trait to her son, V 1.

In chart 3 the trait is inherited for four generations, directly from father to son. II 5 became very bald at forty, as did both of his sons, III 5 and III 6, and also his grandson, IV 4. In the families charted, where the inheritance is direct from father to son, the pattern and age of appearance vary slightly in succeeding generations. In this case in chart 3 baldness covers the entire top of the head and extends down almost to the neck. The hair is lost at about forty years of age. II 8 inherited baldness from his father, I 2, but accurate information could not be secured. IV 1, a woman, has a bald spot at the back of her head. Her father, III 4, was bald and her mother, III 3, was a carrier, inheriting the trait from her father, II 1. The daughter, IV 1, inherits a duplex condition, as both parents transmit the trait. Neither of her sisters, IV 2 and IV 3, is bald. The expectation of baldness in the daughters from a mating of this description would be one in four.

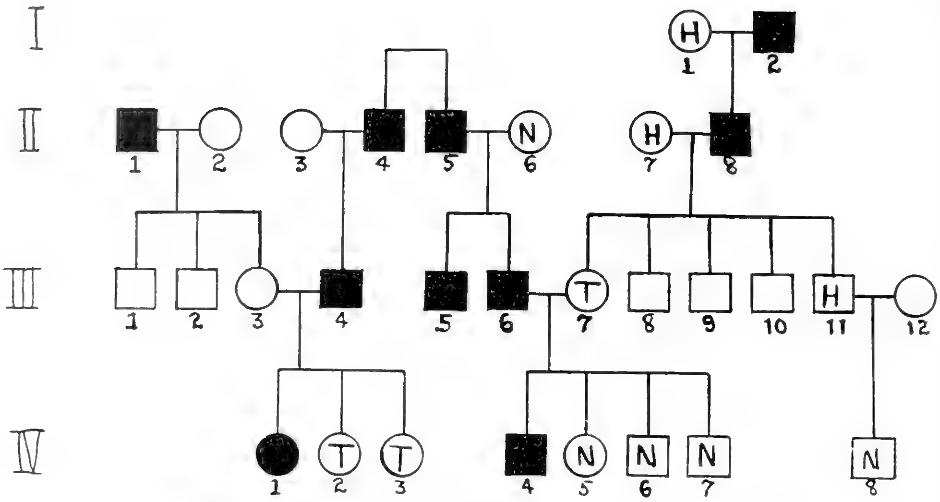
Chart 4 shows many interesting conditions. I 2 became bald at rather an early age and had quite an extensive pattern. Her four sons, II 3 and II 4, by the first, and II 6 and II 8, by the second marriage, were all bald. Unfortunately little is known of the first two, but the two latter showed the same pattern as their mother. Having all of her sons bald would indicate that she herself was homozygous for the trait. In the families studied this holds good for two of the other three bald women, who married and had sons. The fourth bald woman, not charted, had typhoid fever when she was forty and afterwards lost the hair on the front of her head. Her father was bald. Five of her nine sons were certainly bald, two are questionable, and two were not. This is a case of baldness in a woman caused by ill health in addition to an inherited tendency. Returning to chart 4, II 5 was bald, inheriting only the simplex condition, but upon inquiry it was ascertained that she had poor health all of her life and did not become bald until rather late. Her sister, II 9, may also have been bald, but data concerning her are too uncertain to put her down as such. Her two sons, III 15 and III 16, were both bald. II 2 must be a carrier, as one son, III 9, is bald and one daughter, III 3, is a carrier, transmitting the trait to one son, IV 2. III 9 is bald and III 10 is a carrier, as is shown by the amount of baldness in their children.

HIS BROTHERS ARE BALD

This individual, age 31, has a heavy head of coarse hair. His two younger brothers are bald—one at the age of 22. His father is bald but his mother's family showed no baldness. The individual here shown evidently did not inherit the bald pattern, and therefore retains his hair in spite of the fact that he has had typhoid fever and other illness, and therefore has had every chance to express the inheritance if he had it. Obviously, baldness is a segregating character which may go to some of a family, but not to all unless it comes from both sides of the ancestry. (Fig. 5.)

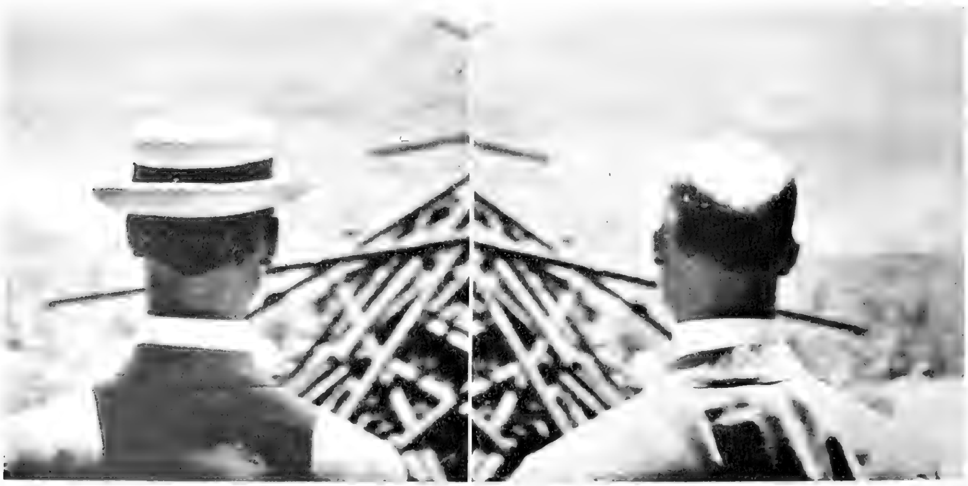
Four sons, IV 8, IV 9, IV 12, and IV 13, are all bald. The other two sons, IV 14 and IV 15, are still too young to show whether they have inherited the trait or not. A daughter, IV 10, has recently become bald. She inherits the duplex condition because both of her parents transmit the trait. Another daughter, IV 11, shows no signs of baldness.

In chart 5 there is shown an unusual number of bald women. I 1 was completely bald; I 2 is questionable; II 2 was partly bald; while II 3 and II 4 were completely bald. II 1, husband



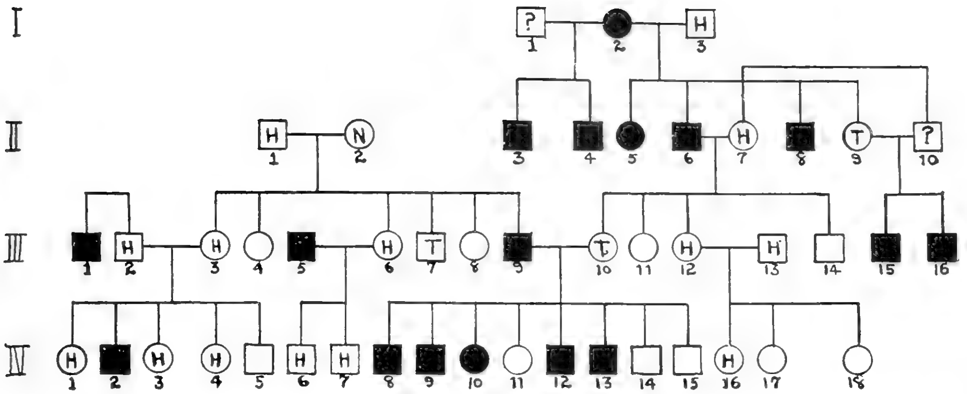
A TYPICAL CHART OF FAMILY BALDNESS (Chart 3)

Generation I. I 1 had heavy hair. I 2 was bald.
Generation II. II 1 was bald. II 2 is unknown. II 3 is also unknown. II 4 was bald. II 5 became very bald at forty. II 6 was not bald but her family history is unknown. II 7 had heavy hair. II 8 was bald.
Generation III. III 1 and III 2 died in infancy. III 3 was not bald herself but was a carrier. III 4 was bald. III 5 and III 6 both became bald at forty, showing the same pattern as their father. III 7 had thin hair. III 8, III 9 and III 10 are questionable. III 11 has heavy hair. III 12 is not known.
Generation IV. IV 1 has a bald spot at the back of her head. IV 2 and IV 3 both have very thin hair. IV 4 became very bald at forty, having the same pattern as his father. IV 5, IV 6 and IV 7 all have a normal amount of hair. IV 8 has a normal amount of hair. (Fig. 6.)



THE HAT IS NOT TO BLAME

Two views of the same individual, showing that the bald pattern is *above* the point where the hat binds the scalp. If baldness were due to the hat, it would be expected to begin at the line where the hat binds the head and, according to theory, cuts off the supply of blood. As a fact, the baldness is distinctly a matter of inheritance; it may appear in families where tight hats are worn; and on the other hand no amount of hat-pressure will cause it to appear in families where the hereditary determiners are not present. (Fig. 7.)



INHERITANCE OF PATTERN BALDNESS (Chart 4)

Generation I. I 1 is questionable. I 2 was very bald on the top and front of the head. I 3 had heavy hair and retained same to an advanced age.

Generation II. II 1 had heavy hair. II 2 had normal hair but was probably a carrier. II 3 and II 4 were both bald. II 5 had very poor health and was much older than the other members of her family when baldness first appeared. II 6 and II 8 were twenty-five when they first became bald and show the same pattern as their mother. II 7 had heavy hair. II 9 had very thin hair and it is thought that later in life she became bald but nothing definite concerning it is known. II 10 is questionable.

Generation III. III 1 was bald. III 2 and III 3 had heavy hair. III 4 is not known. III 5 was bald. III 6 had heavy hair. III 7 had thin hair. Nothing in reference to the hair is known about III 8. III 9 is slightly bald. III 10 has very thin hair and is evidently a carrier. III 11 died at an early age, as did also III 14. III 12 and III 13 had heavy hair. III 15 and III 16 both were very bald and probably became so at the same age as their uncles.

Generation IV. IV 1 had heavy hair as did also IV 3 and IV 4. IV 2 was bald. IV 5 was not bald but the amount of hair is unknown. IV 6 and IV 7 had heavy hair. IV 8, IV 9, IV 12 and IV 13 all became bald at about twenty-five and show the same pattern as the maternal great-grandmother. IV 10 has recently become bald, the cause assigned being illness, but the real cause is probably heredity. Both IV 14 and IV 15 are still under twenty years of age. IV 16, IV 17 and IV 18 all have heavy hair. (Fig. 8.)

TABLE I.—*Inheritance in Men*

Matings	No. matings	Sons	No. bald		No. not bald.	
			Expectation	Actual	Expectation	Actual
BB×Bb....	2	3	3	3	0	0
BB×bb.....	5	13	13	12 1?	0	0
Bb×Bb.....	4	16	12	10 2?	4	4
Bb×bb.....	49	108	54	64	54	44
bb×bb.....	24	43	0	0	43	43

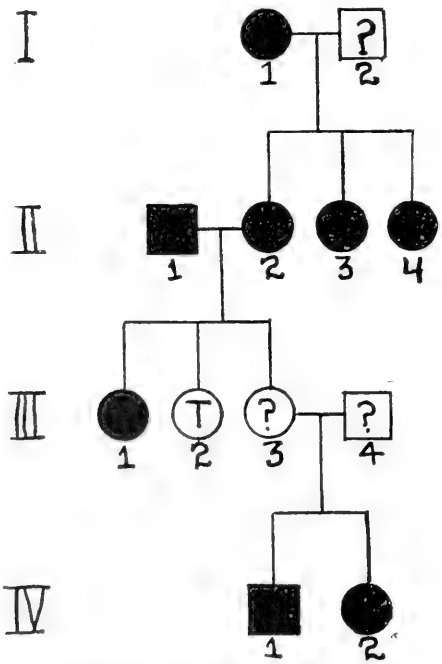
Inheritance in Women

Matings	No. matings	Girls	No. bald		No. not bald	
			Expectation	Actual	Expectation	Actual
BB×Bb....	2	5	2.5	2 1?	2.5	2
BB×bb.....	5	8	0	1 1?	8	6
Bb×Bb.....	4	9	2.25	2	6.75	7
Bb×bb.....	49	59	0	0	59	59
bb×bb.....	24	54	0	0	54	54

B indicates the presence of baldness, and b the absence of it.

Many of the women are carriers, but as all could not be determined no attempt was made to tabulate them separately.

The one woman of formula BB×bb who was bald became so through poor health in addition to a simplex inheritance.



BALDNESS IN WOMEN (Chart 5)

Generation I. I 1 was completely bald. I, 2 is questionable.
Generation II. II 1 became bald at fifty-five. II 2 was partially bald. II 3 and II 4 were both completely bald.
Generation III. III 1 was completely bald became so at twenty-five. III 2 had very thin hair. III 3 is questionable, as is also III 4.
Generation IV. IV 1 has been completely bald ever since he was twenty-five. IV 2 is partially bald. (Fig. 9.)

of II 2, became bald at fifty-five. In a mating of this description one-half of the daughters would probably be bald. Actually, one daughter, III 1, became completely bald at twenty-five, III 2 was never bald and III 3 is questionable. She probably became bald as both of her children, IV 1 and IV 2, were bald. IV 1 was partly so and IV 2 became completely bald at twenty-five. Considering B as the presence of baldness and b as the absence of it, the mating in the first generation was probably BB by BB. However it was not tabulated because of the uncertainty.

In the tabulation of the twenty-two families studied, the actual results coincide almost exactly with the expectation, except in the column marked Bb by bb. The discrepancy between the number of sons and daughters exists because some families submitted did not consider any members but the men. The excess of bald men over men who are not bald can be accounted for by the fact that some of the matings were probably Bb by Bb or BB by bb. Women who are Bb cannot be distinguished from bb. They were all considered bb unless definitely known to have male relatives who were bald. Men BB for the trait are no different from those who are Bb. Consequently all bald men were recorded as Bb.

While the study is not complete

these are the conclusions that can be drawn from the work already done.

Baldness is inherited as a dominant character from father to son, and may be transmitted through the mother though she is not bald. A man who does not show baldness himself cannot transmit it to his children.

Baldness behaves as a recessive in women, appearing only when the inheritance is duplex. It is a sex-limited trait. This explains why baldness is uncommon in women, but also explains the few existing cases.

Some women become partly bald through illness in addition to an inherited (simplex) tendency.

The other theories advanced as to the cause of baldness are not satisfactory. Diseases of the scalp cannot explain pattern baldness. Very heavy hair is often associated with entire baldness on the top of the head.

Illness explains a few cases, but cannot explain the great prevalence of baldness. It does not explain why some individuals in extremely poor health retain heavy hair, and many healthy people become bald. In case baldness is due to poor health there is also an hereditary tendency.

Pressure on the scalp, as an explanation, is unsatisfactory. Many men wear tight hats which do not affect the persistence of the hair. A few of the bald men in the families studied had worn tight hats, but the majority had carefully avoided them. Contrary to the main argument in support of this theory women do become bald. It is an uncommon occurrence, but the charts readily explain that. Few people realize that the condition exists because women can conceal their baldness much more easily than men.

These theories do not agree, and none in itself is satisfactory. Heredity as a cause of baldness explains away these difficulties. It explains the presence of a pattern, why healthy individuals are afflicted, and why it is so common in men and exceptional in women.

The Nassau County Survey

The eugenic survey of Nassau County, Long Island, New York, which was described in the May issue of this journal, is well under way. It consists essentially of an examination of selected persons in all parts of the county, and all persons in selected parts of the county. The first object is to find the amount of mental defect in the community; the second is to get a picture of the eugenic constitution of the community, showing the economic productivity, health, and fertility of various sections. The director of the survey is Dr. A. J. Rosanoff, of Kings Park State Hospital, and the general supervision is in a committee, made up as follows: Dr. Charles B. Davenport, director of the Eugenics Record Office, chairman; Prof. Stephen P. Duggan, Professor of Education, New York City College; Elizabeth E. Farrell, Inspector of Ungraded Classes, New York City Public Schools; Homer Folks, secretary, State Charities Aid Association, New York City; Dr. Thomas W. Salmon, medical director, National Committee for Mental Hygiene, New York City; Dr. August Hoch, director Psychiatric Institute, Ward's Island, N. Y.

The American Genetic Association feels that such research work as this is the most important contribution that can be made to eugenics at the present time. As a mark of this appreciation, the above-mentioned members of the survey committee have been added to the research committee on eugenics, of this association, for the current year. Dr. Davenport has been for many years secretary of this committee.

EVOLUTION AND MAN

Several Human Races Likely to Merge and Form One Great Hybrid Race in the Future—Variation Thus Created Will Present Many Possibilities to Eugenics—What Eugenics Can Do at the Present Time

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CHANGE of emphasis is as characteristic of scientific thought in its progress as is change of style in clothes. Today genetics has the stage. A generation ago biologists were discussing evolution. A half generation later the strenuous discussion as to the inheritance of acquired characters was just closing with a recognition of the lack of evidence in favor of such inheritance. Natural selection became dominant; sexual selection being increasingly questioned except among humankind. Orthogenesis was generally accepted as of some moment.

This idea, however, of definite trends in evolution (orthogenesis) secured less attention than it deserved until the discussion of the inheritance of acquired characters became less absorbing. It was then that the abundant paleontological evidence of evolution by minute changes, too minute to be of "selection value," came to be recognized not as establishing the inheritance of the effects of use and disuse, but rather as indicating the presence of trends of variation in particular directions. It even became evident that these trends in definite directions might produce hurtful results, even leading to the extinction of species.

The huge saurians developed to such size that their very bulk aided in their extinction. The trilobites, so prominent in many fossil faunas, became extinct after a development which culminated in most bizarre forms, so eccentric as probably to indicate an unbalanced condition physiologically as well as structurally. To the paleontologist it is clear that in a number of groups of animals the highly evolved forms have become extinct, the several groups being represented today by forms much simpler than many that have perished and perished very likely because of overdevelopment.[1] The minute changes in the structure of the feet and in the ridges of the grinding teeth in the horse, familiar to anyone who has read any book upon evolution, cannot by any stretch of the imagination be regarded each as of such value to their possessor as to have determined his survival in the struggle for existence. A better example of orthogenic change, showing inherent trends, could hardly be given. And these changes are not step by step related to utility. Indifferent for long geologic periods during their gradual development, they have now, however, culminated in a condition of specialization so extreme as to threaten the extinction of the horse. Only domestication saves him. The horse is a most grotesque, outlandish animal, a one-toed beast with a head as long as a barrel, a stiff inflexible animal that can't even lie down, much less roll over, without an awkwardness beyond belief, if we had not seen it. Only familiarity breeds respect for the horse. He has a stiff, unplastic quality, is overspecialized until he can fit into only a very narrow field in nature, living in herds upon open plains. Man's spread over the earth has produced a change in environment to which the horse could never adapt himself unaided. Indeed, barring the effects of domestication by man, the whole great group of the Ungulates is on the same road to extinction which the Dinosaurs have traveled before them. The destructive effect of evolution is a

[1] This does not imply that many less-developed forms have not perished also. Over-development is not the only cause of extinction.

subject worthy of extended treatment, but it is not quite germane to the main thesis of this discussion.

Our paleontological records indicate that orthogenesis has been a widely prevalent factor, and in our mental picture of the evolutionary process it should be given a salient position. Natural selection has consisted largely in the elimination of species whose unfitness was shown only after a long period of indifferent orthogenic development. In human evolution and in the growth of human culture as well, such trends may well have played a major rôle. The relative immunity of certain races[2] to altruism, which has more or less infected some other races, chiefly since Jesus' time, may profitably be considered from the standpoint of racial qualities as developed trends.

ISOLATION OF HUMAN RACES

Gulick and Romanes brought out very clearly the importance of isolation as a factor in evolution, and it is of especial interest in human evolution. The development during the last half million years of so many races of men, some now extinct, some persistent as relatively pure stocks, others intermingled, has been greatly influenced by isolation, has indeed been possible only through this factor. The spread of man over the whole of the habitable earth and the development of communication are destroying isolation and removing it as an influence in the evolution of man. We are approaching the time when every man may fairly be called every other man's neighbor. Intermingling of the peoples through travel, and that breaking down of social bars which always results from the growth of cosmopolitanism, are rapidly reducing the hindrance to amalgamation of the races which existed during the now passing age of relative isolation. It seems clear that there is destined to be but one race of mankind in time, a highly hybrid stock to which all of the present races which are able to persist shall make their contribution.

Both processes, extinction and fusion, have been taking place in America's short history, and with such rapidity that they can actually be observed. The unplastic Indian of the East and of the Great Plains and the still more conservative Pueblo Indian of the dry country of the southwest, are disappearing and seem destined to extinction. The negro, on the other hand, is increasing and is rapidly being whitened in spite of strong distaste on the part of the white race to intermarriage and the enactment of stringent laws against such intermarriage. A still better example of the impotence of social ostracism to stay the process of racial fusion is furnished by the Jew, whose blood is strongly infused into all the major nations of the Occident. The Syrian Jew is plainly a Syrian, the German Jew largely a Teuton, the Spanish Jew has absorbed many Spanish characters. Each of these Jews resembles his local neighbor more than he resembles his brother Jew of another country, and this racial fusion has come about in spite of a social ostracism of centuries more rigorous than we of today, especially we Americans, can adequately conceive.

Given racial contacts, even the illegitimate unions, it seems, must be sufficient in time to cause fusion of all races into one. Of course to the biologist, accustomed as he is to think of evolution in periods of geologic time, a thousand years are as one day. The amalgamation of the races of man into one race about as homogeneous as the present European population will doubtless take a few thousand years to accomplish, but, so far as we can judge from the conditions now existing and those seemingly necessarily about to come, such union of the races seems inevitable. And it has one feature of great advantage: it will give in the resultant race a great variety and diversity of unit qualities to be manipulated in eugenic marriage. The greater the range of qualities the greater the possibilities, for both good and evil.

[2] The author has in mind here the Greeks and the Germans, peoples whose philosophy of life has been self-development rather than service.

From the point of view here suggested the most interesting ethnic questions are: first, those concerning the ability of any human stock to survive in the competition, and second in regard to the character of the contribution of any surviving race to the ultimate human race and its effect upon the ultimate race. To the biologist such social problems as immigration and internationalism, while timely and important today, seem very transient.

Thus far we have mentioned only long familiar factors of evolution. There has been some change of emphasis in these fields, but no new discovery. In the field of heredity, on the other hand, there has been discovery, and a new science—genetics—has been born. We have found that there are two fundamentally distinct types of variation—the first producing new qualities that are not transmitted in breeding, and the second producing characters that persist and breed true. The latter are mutations and are the material with which evolution deals. The transient, unstable type of variation is but shifting sand and gives no foundation for the erection of any superstructure of evolution.

TWO KINDS OF VARIATIONS

In discussions of these relatively new phases of the science of heredity there has been undue emphasis upon some of the less vital features. It is true that the changes produced by mutation (variation of the stable type) are generally somewhat greater than are the changes seen in fluctuating, unstable variation, but this distinction is not universal nor really of much moment. It is the heritability or non-heritability of any newly acquired quality that is of fundamental interest. The usual British terminology, which calls the non-heritable variations continuous and the heritable discontinuous, emphasizes the minor fact that the former are usually slight and the latter greater in amount. It seems far better to call them unstable and stable, emphasizing thus their most fundamental quality of non-heritability or heritability.

Not only have we learned this great distinction between heritable and non-heritable qualities—we have also found out a few fundamentally important things about the manner of inheritance of the heritable qualities, of the way they behave in inheritance. We think we know that the resemblance between parent and child is not a vague general resemblance, that the child does not inherit resemblance to either parent as a whole or a sort of fused resemblance to both, but rather that he inherits particular qualities, or to be more accurate, inherits a series of determiners each of which is related to the development of a particular quality. We think too that we have found satisfactory evidence that in general the child carries two determiners for each heritable quality, one received from the father, another from the mother.[3] We are beginning to learn something of the interrelation and interaction of the two determiners of each pair within the body of the child, and especially we think we know some fundamentally important features of their behavior in connection with the process of fertilization, which starts a new individual in life.

This is not the place to discuss the phenomena of genetics in any detail. Suffice it to say that inheritance is not vague but definite, not general but particular. Stature is not inherited but rather the child receives from its two parents a whole double series of determiners which guide the development in a number of particular ways affecting stature. Brown eyes are not inherited, but rather apparently two pairs of determiners, each pair for a distinct pigment, whose combination produces a brown iris. Brown hair, red hair, flaxen hair, is not inherited as a whole, but rather there seem to be two pairs of hair pigment determiners which when present in full activity produce even so-called black hair, and the absence or perhaps the relative inactivity of one or more of these pigment

[3] One or occasionally both determiners of a pair may be absent, the quality itself being in the first instance less developed and in the second instance wholly absent.

determiners results in various lighter shades. In the complete albino all pigment determiners are absent or at least inactive. It is altogether possible that specific activators must ultimately be brought into our conceptions of inheritance.

INHERITANCE IS PARTICULAR

The thing desirable to emphasize here is the particularity of inheritance. Every individual is a complex of minute discrete qualities which in inheritance act more or less as independent units and so are commonly called unit characters. As the independent inheritance of discrete qualities was first discovered by Gregor Mendel, these unit qualities are often called Mendelian units, and their inheritance as independent characters is called Mendelian inheritance. It seems to many students to become more and more evident that all physical inheritance is Mendelian, though the phenomena are often so complex that their complete Mendelian analysis, their analysis into units of inheritance, is extremely difficult or even completely baffling. All this is distinctly new.

The science of genetics is but a half generation old and it is still in its infancy. Great progress is being made, American biologists marching in the van, but the fields still unexplored are vast and many decades are needed for their conquering.

For our present consideration the thing of interest is the fact that we have learned to some extent how to get results from directed breeding. We know how to breed out and throw away particular unit qualities and we know how, on the other hand, to collect and increase them. Having certain unit qualities in a given lot of animals of any species, and having so analyzed them that we know them as units and understand their reaction in combination, we can shuffle them as we will and produce all sorts of combinations within the limits that the life processes place upon our experimentation. One point of much importance must be emphasized. While breeding can combine qualities already present in the selected individuals, and nurture can often bring such qualities to fuller development, neither breeding nor training can put in what is not already present. We can make new combinations, but we cannot create new qualities. For these we are dependent upon Nature's gift. We must make the best of what she provides.

How does this advance in our knowledge of heredity affect the future of man? How about eugenics? Can we control human development and evolution? There are a number of subsidiary questions that need answering before we can speak confidently of the larger matter of human eugenics. If we should control marriage to this end, we could, of course, produce great physical change in man. With sufficient study probably we may come to understand the unit qualities in most if not all of his physical constitution and we may hope to know how these behave in inheritance. May we hope to analyze psychic qualities into units of inheritance? Are there such psychic unit qualities, and if so are they within reach of our analysis? Are there such things at all as heritable psychic qualities? At least one American psychologist is very skeptical of the inheritance of psychic qualities and regards as especially improbable the whole idea of units of inheritance in psychic qualities.

I know that in the field of psychology I "speak as a fool," yet as a fool, I am convinced by the evidence that psychic inheritance is a fact. We don't know what that which we call disposition is, but it seems to be a complex of psychic qualities, and among men and domestic animals it seems to be heritable. A Jersey bull or a Spitz dog is of uncertain temper. A Hereford bull or a Newfoundland dog is more dependable. These qualities are heritable. Individual dogs of the same breed differ in intelligence and in disposition and, though the evidence is as yet not carefully scrutinized, we are all convinced that such individual differences are heritable. Is the savagery of the Apache or the mildness of the California

Digger Indian any less heritable? Admit to the full the influence of training, especially of subconscious training, and still it seems we must believe that qualities of intellectual ability and of disposition are inherited and that moral stamina and moral weakness are not wholly matters of education. Indeed one is inclined to believe that at bottom these qualities, when strongly present, are less affected by training during the life of the individual than has long been thought, and of course their inheritance is not at all so affected.

MENDELISM IN THE MIND

But if we grant that psychic qualities are heritable, and not merely racial qualities but individual qualities as well, we are still without satisfactory evidence of the presence of Mendelian units in psychic inheritance, and of the manner of their behavior in transmission. If there be units of psychic inheritance, their interrelation may be too complex for analysis. There is no certainty of completely satisfactory solution of the problem even in the distant future.

Leaving out of account for the moment all social considerations and viewing the problem of human eugenics as we would that of animal breeding, could we, if free to do so, so manipulate human beings in marriage as to control psychic as well as physical qualities? Is analysis into Mendelian units necessary to success in breeding?

Thorough analysis is surely the greatest aid, but some result is possible without it. Burbank never analyzed his problems, but he got results, as did all the breeders before his day who produced our diverse breeds of domesticated animals and plants. To be sure they met many failures, but they had some successes. Galton, Pearson, and their followers in the British school, show little interest in Mendelian analysis and are approaching problems of human inheritance from a very different angle. How far we could go by their uncritical method is a question, but something we could surely gain. We could eliminate the undesirable and advance the race nearer to its present best.

But under conditions as they are can we do this? How much hampered are we by social limitations?

Looking far into the future I have entire confidence that we shall in time almost banish physical, mental and moral[4] invalidism, which today are most prominent characteristics of the human species. Negative eugenics, the elimination of the clearly unfit from parenthood, has come and with more knowledge, will be more important, whether the unfitness be physical or psychical. To be sure it may be a thousand years or two before we approach this goal, but to a biologist this is but tomorrow. For the sociologist who thinks in decades there is less comfort in the prospect, though there is much to justify a hope that progress is to be really rapid, a few centuries accomplishing much.

How is this to be? What is the method of approach? *First*—promote the study of the science of genetics by great foundations richly endowed. *Second*—gather with thoroughness and the greatest possible completeness data as to the now existing human stocks. *Third*—educate to ideals of eugenics. *Fourth*—legislate. A few words about each of these four exhortations.

Study of the Science of Genetics.—There is work here for many students for many decades. It must be unhampered, purely scientific work. There must be no necessity of producing "practical" results in order to appeal to the popular imagination and gain financial support. Get good men, then let them alone, don't pester them, and in time there will be gathered a great body of carefully scrutinized data upon which to found intelligent practice of eugenics.

Gather Data as to Existing Human Stocks.—The state should at once gather the fullest data as to matters of possible importance for eugenics (and perhaps as to other things of interest in connection with inheritance) for all families represented in our public insti-

[4] This is used as a conventional, not a strictly scientific classification.

tutions for the care of the defective and delinquent, and similar data should be gathered by privately endowed institutions of similar purpose. Privately endowed investigations should gather inheritance data as to all types of human stock, especially the most desirable. All these data should be gathered, studied and filed by thoroughly trained experts. They should be open to inspection only by those who can show valid reason for such privilege. Contemplation of marriage by or with a member of any family included in these records should of course make the records available for study. In imagination one can see the day when inheritance records will be made by the State for all individuals and these files be the most valued of all records, but that day is far distant.

THE EUGENIC CONSCIENCE

Education to Ideals of Eugenics.—This includes, first, the education of college and university students in the phenomena of inheritance and, second, education of society to an appreciation of the necessity and beauty of the practice of eugenics. This education of society will come chiefly through the pulpit, the stage, our novelists, poets and essayists. The education will not be real and vital until it has taken such hold of the imagination and has so molded ideals that non-eugenic marriage shall seem unbeautiful and repellant. There is no other crime so heinous as intentionally sharing in bringing into the world a human being who, there is reason to believe, will be an injury to society. This is vitiating the very fibre of the human stock. Not only is the bearing of such children criminal—accessory to the crime are charitable persons, or professional workers in charities, who express their sympathy for the individual in ways that result in such injury to society in the coming generation. The agents of our charitable organizations and the officials guiding state activities in relation to the defective and delinquent, often do not now have in mind the rights of society in the coming generation, to safeguard those rights. But, of course, appreciation of the principles of eugenics, and respect for them, is a primary requisite for fit service in these lines and should be so recognized. We know as yet but little in this field, but we must not be false to so much of the truth as we have attained. In promoting ideals of eugenics the immediately practical thing is to educate ourselves and our fellows to a warm appreciation of physical, mental and moral soundness and wholesomeness, such appreciation as will make these qualities the most attractive in choice in marriage. This is a long, slow process, but there is never any short cut to results of really vital importance. After 2,000 years the altruism of Jesus has only begun its beneficent work in those aspects of human relations long recognized. It must reach to and come to be controlling in this newly recognized and higher phase of social morals.

Legislation.—This is a minor feature to one who takes the "long look," but it is essential. Legislation can never express and enforce an ideal that is not general, and one does not see that it can ever be more than purely negative, debarring certain clearly recognized types of defective men and women from marriage. In cases of congenital feeblemindedness and inherited insanity, if accurately diagnosed, segregation may now wisely be used. But legislatures have positive genius for mistaken legislation in scientific matters, and they are sure to be urged by well-meaning but ill-informed persons to enact unwise laws, as some states have already done. Legislation which goes too far or is ill-founded will set back, not advance, eugenics. If one State should enact moderate segregation laws based on sound scientific data and drafted under the advice of those most conversant with these data, it would do great service not only to itself, but also by its example. One concrete instance of wise legislation would not only be a stimulus to other states to enact similar laws but could be used as a deterrent in cases of proposed laws founded on enthusiasm and not on knowledge. So-called eu-

genic legislation to the present time has been mostly unwise and will prove a hindrance.

We have discussed thus far only negative eugenics, the elimination from child bearing of those recognizably unfit. Even without Mendelian analysis it seems probable that ultimately much may be accomplished by the acceptance of more wholesome ideals of attractiveness in marriage. Through centuries of advance in culture, physical attractions have come to be largely supplanted by spiritual qualities as stimuli to choice in marriage. This change shows how possible it is to modify the standards even in this the most vital, most biological, of all human relations. We may surely anticipate bringing the human stock into a condition more nearly approximating its present best by removing the distinctly undesirable types.

CONSTRUCTIVE EUGENICS

Positive eugenics involving controlled marriage for the sake of bringing together individuals whose children would be likely to be especially valuable to society, seems unattainable without violence to the principle that love between husband and wife is the safest, the most beautiful, foundation for the home, and that the home is essential to the best type of society. Possibly in the case of a people like the French, or still more the Japanese, among whom marriage is arranged by the families rather than the individuals involved, considerations of positive eugenics might come to be controlling, as considerations of wealth and social status are today in large measure. But any attempt to unite a particular man and a particular woman in marriage for the sake of establishing the resultant family in wealth or social position or even in innate wholesomeness of body and mind seems to us in America not only repellant but socially dangerous. Man is so sensitive spiritually to the environing atmosphere, especially within the family, that this should be of the sweetest, most ennobling type, and to this end nothing else is so important as that there should be between the man and woman founding the family that indefinable attraction we call love, a thing which in primitive man was probably mostly physical, but which at its best today is permeated and suffused with spiritual quality of a type which does most to make a home environment that molds the children into worthy members of society.

The complexity of the problem of eugenics is evident, and the great difficulty of accomplishing to the full the biological result of good breeding without sacrificing the nurtural influences which, while less fundamental, are still essential. Marriage is a most vital thing to the individual and it is socially the most significant of all human relations. The interests involved are complex and may oppose each other. When individual and social interests clash, of course those of the individual give way. The bearing of children is not an individual right, but a social privilege, which may be bestowed or withheld as social welfare shall demand. The only question is, of course, which way social welfare lies—no easy question to approach, much less solve.

Our discussion of eugenics thus far has dealt only with the problem of bringing mankind as a whole nearly to the level of its present best. This is ordinarily what is meant by eugenics. There is a somewhat distinct problem—that of the evolution of mankind to a condition more advanced even than his present best, the bringing of the race to a point beyond the best yet known even in the most desirable individuals. Is there, or is there not, possibility of indefinite advance in humankind? The question of method of securing advance, a question we have already discussed sufficiently to show its complexity, enters here, as it does into eugenics. But there is a further question of material upon which to work. We have convincing evidence that changes effected in an individual through education are not heritable. We have seen also that there are two types of variation producing new qualities which in the one case are heritable, in the other not. Only heritable qualities, stable variations, mutations, can serve as a basis for

evolution. Is man mutating today? Does he present stable variations which may be utilized to secure his evolution to a higher condition? The various species of animals and plants differ in the degree of their mutation. The domestic goose has developed few breeds because it presents few and slight mutations from which to breed new forms. The common pigeon,[5] on the other hand, has evolved under artificial selection into a host of very divergent breeds. To which type does man belong? Is he mutating or not? By his fruits we can know him. Does the species show high diversification into races, or has it remained fairly uniform?

SEVERAL SPECIES OF MAN

We have evidence of at least two species of true men, the Neanderthaloid species, *Homo neanderthalensis*, with perhaps more than one race, now wholly extinct, and *Homo sapiens*, with at least three subspecies represented in Europe and with numerous very divergent races scattered throughout the habitable earth.[6] To reach this condition of great diversity, mutation must have been frequent and considerable in degree in the past, and we have no reason to suppose it less today. Few species of organism show more abundant or more extreme mutation than man. The races of men differ not only in such physical characteristics as stature, color, shape of cranium and of face; form of features; color, position and shape of eyes; color, shape and coarseness of hair; relative length and size of different portions of skeleton; form and size of teeth; and numerous others—they differ no less in mental qualities, in intellectual ability, in educability, in disposition. Yes, mutation, physical and mental, has been prevalent in the past and is doubtless continuing today.

Much of the change we see appearing in human families from generation to generation may be but the resolution and recombination of qualities already in this highly hybrid stock, but the evidence from his past shows almost beyond question that new features must be appearing through mutation and joining the huge jumble of qualities which are reshuffled with every marriage. Along with the ancestral qualities and the new mutations, all heritable, are of course numerous non-heritable features which have arisen by variation of the non-stable type. The condition is one of great complexity, difficult of analysis even if we were free to use experimental breeding. Without experimental breeding, using only observation of chance matings, as is necessary under the conditions presented by human society, the analysis of the conditions presented seems nearly hopeless. We shall learn something, much in time, but it will be slow progress at the best.

New qualities which arise in any species are often slight at first, their value appearing only after generations of orthogenic intensification. In experimental breeding many such must escape notice and be lost. Among humankind any quality to be repellant or attractive in influencing marriage must be well developed and prominent. Marriage selection, therefore, cannot act upon any new quality unless it be well developed at its origin (what breeders of animals and plants call a "sport") or until, if slight at first, it be given probably many generations to develop and become prominent. We should note further that by the time adult life is reached every individual has been so modified by education and by self-training that his inborn character is obscured, so that he may be chosen in marriage on the basis of character which in considerable degree is "acquired" and therefore is not transmissible. The subject is extremely complex. Not even its outlines can be indicated in this paper.

What conclusion, if any, can we

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[5] It is possible the domestic pigeon is of hybrid origin. Better examples of non-mutating and mutating stocks would be the potato, which has shown little divergence under prolonged cultivation, and the wild cabbage (*Brassica oleracea*) which has been developed by selection of its mutants into the domesticated cabbage, kale, Brussels sprouts, cauliflower, kohl rabi, and Swedish turnip, leaf, flower and stem all having been greatly modified.

[6] Cf. Osborn, Henry Fairfield, "Men of the Old Stone Age," New York, 1915.

reach? Can genetics and eugenics register in human betterment, in improvement of the stock itself? Surely they can if we will have it so. But will we consent? Again surely yes. The ideal of a human race wholesome in its innate character is so beautiful that it must win its way. Caring for the weak, comforting the sick, rescuing and regenerating the base, are beautiful, but how much more beautiful it is to build a race that is physically sound, intellectually keen and strong and whose natural impulses are wholesome! Not a race of men who are decent because they are restrained from following their natural bent, but a race whose natural quality is wholesome, who need not so much to restrain as to develop themselves. This seems destined to be included in the religion of the future, and it is Christian; not in Jesus' thought, so far as we can judge, but a necessary development of his gospel of altruism. If the facts of human inheritance are as they seem to be, man's future takes on a new glory.

ANTITOXIN FOR CIVILIZATION

Thirty years ago Carpenter[7] wrote a keenly interesting essay in which he depicted civilization as a disease from which no people, once afflicted, has ever made a good recovery. He traced its history in several peoples, showing its similarity in all, the same prodromal stages, its culmination in feverish strength, and the patient left either dead or permanently weakened. It was not a pleasant study, for it had too much of truth. The people who make eugenics part of their religion and are loyal to its truth will have found the antitoxin for this dire disease, and with it the fountain of youth. But this is a dream of the distant future, the day of that ultimate race that shall people the whole earth. Yet we can carry this dream with us, can have the inspiration of the vision, and can be loyal to it in our endeavor to secure to children their right to be well born.

We have said that the gospel of eugenics is Christian. Can any follower of Jesus see this ideal understandingly without finding that all his loyalty to Jesus' gospel of altruism is back of it to push it? Eugenics is also Confucian. This religion of common sense maxims, if it be called religion, has broad contacts with the religion of eugenics. There are also possible considerable contacts with Buddhistic philosophy. Forgetfulness of self and merging all into the infinite completeness of the whole Communion of the Universe are ideas that readily unite with the ideal of eugenics. Islam is not sufficiently altruistic to let us hope that it can help toward the enforcing of eugenics, though pride of birth and joy in worthy sons is highly characteristic of many Mohammedan peoples. Shintoism might be brought to urge improving the quality of those who are to be given as ancestors to posterity. The contacts with Shintoism may conceivably prove of practical value.

Among the civilizations of the world positive antagonism to eugenics is hardly to be expected. Buddhism is too contemplative to push anything. Shintoistic-Buddhistic-Christian Japan, with her readiness to adopt new conceptions if they look to national advantage, may perhaps be among the first to grasp and enforce eugenic ideals. But for its real growth eugenics seems, as a matter of fact, if not of philosophy, to be dependent chiefly upon Christian civilization. It is wholly Christian, though not exclusively so, and nothing less seems truly and adequately Christian.

[7] Carpenter, Edward, "Civilization, Its Cause and Cure." London, 1889.

POLLINATING FRUIT TREES

Many Problems Connected with Failure of Trees to Set Crop—Must Be Worked Out by Experiment—Results of Some Long-Continued Trials in England

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IT HAS long been recognized that the chief purpose of a conspicuous flower is to attract insects, which may act as the agents in transferring pollen from another individual. Failing, however, the arrival of any foreign pollen, many flowers are able to set seed with their own pollen and in fact many flowers are provided with various elaborate contrivances, to effect self-pollination, should cross-pollination fail.

There are, however, a large number of plants, which, even when carefully self-pollinated, are quite unable to set seed or develop fruit with their own pollen.

To this set belong many of our common wild plants, and many of our cultivated plants, too; but what concerns the fruit grower most is that many, if not the majority, of our common fruit trees are in this category.

It has frequently been observed by practical men that large blocks of only one variety of apple or pear have fruited badly, except in the outside rows; others have contended that large blocks of one variety have fruited well all through. Both may be correct, and a good deal of the explanation depends upon a clear conception of the meaning of the term self-sterile. A plant is said to be self-sterile when it fails to set seed with its own pollen, though this same pollen may be perfectly potent on another variety. This should not be confused with such cases as occur in the gooseberry and the currant, where, though the flowers are perfectly self-fertile, fruit is but rarely if ever set, if the visits of insects are excluded; here it is chiefly a mechanical difficulty, as the stamens bearing the pollen are situated in such a position that they cannot come in contact with the stigma, the female organ; and, further, the pollen is of a glutinous nature. The practical difference is that, whereas in this latter case a supply of bees would ensure a crop of fruit, even if only one variety be grown, in the former no number of bees would make any difference.

FRUITS WITHOUT SEEDS

There are some varieties of apples and pears which will set fruit on being self-pollinated, but these fruits do not contain any real seeds; such fruits are of course more or less satisfactory to the fruit grower who wants fruit. This also occurs in some varieties of gooseberries; such berries are, however, decidedly lighter in weight than those containing seed, and are therefore obviously of less value to the grower; the apples without seed, also, are often inferior both in size and shape.

In plums and cherries these parthenocarpic fruits do not occur, at least not to any appreciable extent; an occasional fruit may be found with a shrivelled kernel, but I have noticed that, as a rule, if this shrivelling takes place before the fruit is well developed it falls, and I think that it is probably due to imperfect fertilisation.

Plums seem to be fairly equally divided between self-fertile and self-sterile varieties, and there are a few which cannot be directly classified as one or the other. In apples and cherries, self-fertile varieties appear to be greatly in the minority. Through experiments carried out chiefly on pot trees at the John Innes Horticultural

[1] Mr. Corrie was formerly connected with the John Innes Horticultural Institution at Merton, Surrey, England, of which William Bateson is director. The data here presented were accumulated at that institution. With this article the reader should compare "The Self-Sterility Problem" by E. J. Kraus, in Journal of Heredity, VI, 12, pp. 549–557, December, 1915.—The Editor.

Institution in a house where they were strictly isolated from insects, some of the commoner plums, cherries and apples can be classified as follows:

PLUMS

Self-Fertile	*Self-Sterile*	
Denniston's Superb	Coe's Golden Drop	
Early Mirabelle	Coe's Violet	
Reine Claude Violette	Wyedale	
Myrobalan (red)	Grand Duke	
La Prune Giant	Jefferson	
Monarch	Reine Claude d'Althan	
Early Transparent	Pond's Seedling	
Reine Claude Bavay	Washington	
Prince Englebert	Early Greengage	
Early Favourite	Old Greengage	
Gisborne's	Ickworth Imperatrice	
Oullin's Golden Gage	Late Transparent	
Golden Transparent	Curlew	
Victoria	Prune d'Agen.	
Czar		
Pershore		
Magnum Bonum (red)		
Magnum Bonum (white)		
Kentish	River's Early Prolific	Set only about 1% when selfed
Warwickshire Drooper	Stint	
Damson var's	Mallard	

CHERRIES

Self-Fertile	*Self-Sterile*
Morello	Black Heart
Late Duke	White Heart
	Elton
	Kentish
	Big Frogmore Early
	Big Gaboulay
	Early Rivers
	Guinge d'Annonay
	Black Tartarian

APPLES

Stirling Castle	Northern Greening
Baldwin	Lord Hindlip
Washington	Cox's Orange Pippin
	Bramley's Seedling

Parthenocarpic:
Lord Derby
Duchess of Oldenburg

It will be noticed that on the whole the self-fertile varieties correspond with the best croppers; this, however, though general, is not always the case, for Rivers' Early Prolific, which is usually a great cropper, is from a practical view self-sterile, setting only about 1% of its flowers when self-pollinated. May Duke cherry behaves in a similar manner.

I think it will be found that some varieties of plums are better pollenizers for certain varieties than others; when the Old Greengage and the Early Greengage are crossed together only about 8% of their flowers develop fruit. For several years I observed a large block of two varieties of greengages, and although they produced flowers in abundance they never carried a fair crop of fruit; owing to this they have been destroyed. I think that certain definite varieties of plums may prove to be the best pollenizers for the self-sterile gages. Cross-pollination has indicated this, and I have seen greengages, carrying good crops, growing beside Victoria plums.

If the flowers of self-sterile varieties of plums and cherries are not pollinated at all the fruit falls very soon, a few days after the petals, whereas if the flowers are self-pollinated the carpel swells up to the size of a culinary pea before it falls, but fall it will, and it is not until about three weeks after pollination that a self-sterile variety can be distinguished from a self-fertile one.

These self-pollinated fruits, of self-sterile varieties, tend to fall more quickly after a touch of frost, much to the consternation of the grower, who thinks that he has lost a high percentage of his crop from this cause. The careful observer will, however, notice many fruits falling on both self-fertile and self-sterile varieties, at times when there has been no frost; it is due in the former case solely to lack of pollination, and in the latter to the lack of fertilisation as well.

BEES AND NECTAR

It will be seen that it is very important to know one's varieties and in most cases to avoid planting large blocks of the same variety. It should be borne in mind that all the different trees of the same variety, which have of course been propagated vegetatively from one individual, are so far as self-sterility is concerned, but one individual—no benefit is derived by interpollination between such trees. It is known that bees have a wide-working radius, half-a-mile at least, and often they go further afield. It might therefor be argued by some on this account that there can be no objection to large blocks

POLLEN IS TRANSFERRED THIS WAY

When the bee enters a flower he gets pollen on his head or, if the flower is large, all over his body; and naturally leaves some of it in the next flower he enters. In this photograph (posed and made by David Fairchild) it is evident that from the anthers of a small blossom, the bee must carry away a large part of the pollen on his face. (Fig. 10.)

of one variety. It should, however, be borne in mind that it is nectar that the bees are after, and they are not concerned with cross-pollination, so that if there is one variety rich in nectar, there is no reason why the bees should do anything more than simply work backwards and forwards between the hive and this block. I have noticed that the plum, Denniston's Superb, is extremely rich in nectar, I have seen this variety carrying heavy crops of fruit, year after year, and I am inclined to think that its prolific quality is due to its richness in nectar attracting the bees.

It is sometimes stated that wind is an agent in bringing about the pollination of fruit trees. With some plants it undoubtedly is—in fact many are elaborately adapted for wind pollination, the pollen-grains of some cone-bearing trees having wings which enable them to be freely carried by the wind. To endeavour to discover what part wind plays in pollinating fruit trees, we enclosed two young standard plum trees in muslin of a mesh sufficiently small to exclude bees and large flies but large enough to admit wind freely. One of these trees, a Victoria, bore one fruit; the other, a tree of Reine Claude Violette, did not develop a single fruit, whilst neighbouring Victoria trees carried quite fair crops. Both these varieties are self-fertile, and this clearly shows whether a tree be self-sterile or not. Insects are absolutely necessary for efficient pollination.

Another experiment has shown that the stigma, under the best conditions, begins to deteriorate to a marked extent, in regard to its receptiveness of pollen, the eighth day after the flower has opened and with climatic conditions so adverse as is usual with us in the spring, during the period the trees are in flower, its receptiveness is probably of much shorter duration.

With such existing conditions as these, the value of having hive bees in the vicinity, so that they can work freely on the flowers during the short bright spells which often occur during weather which prevents them leaving the hive, cannot be easily over-estimated. The value of the wild bees and other pollinating insects, should not be over-looked, as they work more freely than the hive bees during adverse weather.

THE EFFECT OF RAIN

The effect of rain upon fertilisation is not, to my mind, so deleterious as is generally thought, for experiment has shown that the application of water on the stigmatic surface, two hours after pollination, has no effect whatever in preventing fertilisation taking place, and it is probable that it would not at a much shorter period if weather conditions were favourable. The applications of water were much more severe than would occur in a practical way from a shower of rain, and, considering the small size of the surface of the stigma, I think that the water that would come in contact with and remain upon it is hardly worth considering. A period of rain, however, would doubtless destroy much pollen, and prevent pollination taking place.

The phenomenon of self-sterility presents but half the problem of the pollination of fruit. There is yet the question of satisfactory pollenizers, and this is of most importance. Taking the extreme for an example: several cases have been found where distinct varieties are of no use whatever as pollenizers for some other varieties. After extensive experiments with Coe's Golden Drop, Jefferson and Coe's Violet, there seems but little doubt that, however these three varieties of plums are intercrossed, no fruit will set. Coe's Violet is supposed to have originated as a bud sport from Coe's Golden Drop; if this is correct an explanation is presented, as it would be really a part of the same individual. In the case of Jefferson, however, no explanation can be offered at present. All these three varieties have been crossed with several other varieties, and have set and developed excellent crops.

Excepting the crossing of distinct species, I am inclined to think that these extreme cases of physiological differences may be rare in plums of the domestica group. With apples, how-

ever, I have reason to believe that these cases may be much more frequent, and if it is found to be so, it will be of great importance to the practical man. The variety Bramley's Seedling appears to be of no use whatever as a pollenizer for Cox's Orange, and there is some indication that many other varieties may be found to be similar to Bramley's Seedling in this respect. Other cases have been found where varieties have been crossed, and yet no seed has developed; the carpel has simply swollen up and I have noticed where seedless apples and apples with seed have occurred upon the same tree, that the former have been to a marked extent, inferior in size and in some cases in shape also.

THE PROBLEM OF AFFINITY

Even with varieties which are potent and do produce seed, there appears still to be a variation in their affinity—the pollen from some varieties appears to set and develop a higher percentage of fruit than pollen from others. Cox's Orange has developed good crops when crossed with Stirling Castle, Beauty of Bath and Duchess Favourite.

Although the pollen of Bramley's Seedling is apparently of no use in effecting the fertilisation of Cox's Orange, the pollen of the latter variety appears to be perfectly potent on Bramley's, and good crops have been obtained. Considering this from a practical view, it is possible that a large block of Cox's Orange might be interplanted with Bramleys only, and if no other varieties were in the vicinity the trees of Cox's Orange would be practically barren, whilst the Bramleys would carry good crops. Extending this view: for all that is known at present, Cox's Orange might even be in the midst of several varieties, and they might all be similar to Bramley's in being of no use as pollenizers, and I am inclined to suggest that in some of the cases where Cox's Orange crops so badly it might be due to such conditions as these prevailing, and also in the cases where they crop so well to having suitable varieties as neighbors.

These variations are in no way due to a deficiency of pollen, nor to the failure of varieties to flower at the same time, which is of course essential.

In cherries also there appears to be slight evidence that some sections, or at least some varieties, may prove to be of little, if any, value as pollenizers for other sections or varieties.[2]

If fruit trees in general can be classified from a physiological point of view, as I am inclined to think they can, it will be of real value to the practical man, as he would then be equipped with a knowledge that would enable him to interplant to the best advantage, and I do not think that this would necessarily involve planting, as pollenizers, varieties which are of little commercial value.

In conclusion, I would say that much is still in a negative stage (and also that possibly some of the cases of inefficiency of varieties as pollenizers, may be found to be more or less coupled with morphological differences), but with further critical investigation there is no doubt that many facts will be discovered which will be of great practical value to the fruitgrower, and probably will throw light on some problems of theoretical importance as well.

[2] This is confirmed by American work. See "Sweet Cherry Breeding" by V. R. Gardner, in JOURNAL OF HEREDITY, VI, 7, pp. 312–313, July, 1915.—THE EDITOR.

Bounties for Babies in France

Child-bearing is to become a subsidized industry in France if a bill introduced before the Chamber of Deputies by Paul Benazet is enacted into law. It provides, as summarized by cable dispatches, that the state shall pay $100 (500 francs) to a mother for the first child born, $200 for the second child, $400 for the third, and $200 for each subsequent child thereafter, making payment a year after birth if the child is living. Such measures are probably based more on the need for soldiers than on any other consideration; they are too indiscriminate to be considered eugenic.

SORREL COLOR IN HORSES

Although It May Be Only a Light Chestnut, Evidence Indicates that It Is Inherited Separately and Is Therefore a Distinct Unit—Sorrel Color the Easiest One for the Breeder to Produce at Will

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THE sorrel color in horses is not officially recognized by most stud books. The following, however, are exceptions to this: The National Registry of Belgian Draft Horses, The National Registry of French Draft Horses, and The American Shetland Pony Stud Book. All others consider sorrel to be a light shade of chestnut.

Since the inheritance of all other colors has been found to accord with Mendel's Law, it occurred to the writer that there was a possibility of determining whether sorrel is a true color. With this point in mind the matings in The National Registry of Belgian Draft Horses were examined as a source of information.[1]

More than half of the records in the Belgian stud book were covered in order to obtain evidence for, or against, the question at hand. A large proportion of the animals recorded in these books have been imported, and not bred in the United States, and it was therefore impossible to learn the color of the sire and dam of such animals. Work was begun on the most recent volume published, and the preceding volume taken up as the information in the succeeding one was exhausted. Finally a point was reached in the records where the number of animals recorded, that had been bred in this country, was so small that the information gained by going over these records was almost negligible. It was then deemed advisable to stop the work and analyze the data compiled.

At the outset the color of all matings together with the color of offspring of such matings was recorded for comparison with the results compiled by W. S. Anderson.[2] After 400 matings had been tabulated it was apparent that, not considering sorrel, the findings were as nearly like Anderson's as would be expected. From this point only such matings were recorded as were considered of value in determining the inheritance of sorrel.

The final number of matings tabulated is 427, which involves the color of over 1,250 animals. This seems a sufficient number from which to draw conclusions as to the inheritance of sorrel color.

In previous work done on the inheritance of coat colors all other colors were found to be dominant to chestnut. However, the records from which those data were compiled entirely disregarded sorrel as an individual color.

In the table on p. 371 it is seen that from the sixty-three sorrel by sorrel matings sixty-one sorrel, one bay, and one roan offspring resulted. Upon inquiry, the breeder of the bay animal made the following statement as to its color:

"Both the sire and dam were sorrel in color but of a very light shade, and the colt was so light in color that after the coat had been shed once the animal was so light as to make it impossible to distinguish whether it was bay or sorrel."

However, he failed to state whether the mane and tail were light in color, which is characteristic of sorrel, or whether they were black, which is characteristic of bay.

The roan pattern being dominant, it is readily seen that the one roan animal

[1] Much valuable assistance was received from Prof. W. M. Barrows, Department of Zoology and Entomology, Ohio State University, under whose direction this work was carried on.

[2] Anderson, W. S., "Coat Color in Horses," Journal of Heredity, V, 482–488, November, 1914; and in more detail in Kentucky Experiment Station *Bulletin* 180.

MATINGS OF VARIOUS COLORS AND COLOR OF OFFSPRING

Sorrel	Bay	Brown	Chestnut	Black	Roan
		Sorrel x Sorrel			
61	1	0	0	0	1
		Chestnut x Chestnut			
5	0	0	13	0	0
		Sorrel x Chestnut			
23	3	0	11	0	1
		Sorrel x Bay			
78	95	3	5	10	6
		Sorrel x Black			
9	8	0	1	6	1
		Chestnut x Black			
1	2	1	1	1	1
		Chestnut x Bay			
22	48	0	8	1	0

recorded as an offspring in the sorrel by sorrel cross is due to a mistake in recording, or that one of the parents was a roan animal with a very few white hairs showing, which is a case of incomplete dominance. Occasionally, animals are seen which from a distance appear to be sorrel, chestnut or bay in color, but upon close observation a few white hairs are apparent in the coat. It has been found by other investigators that there are a small number of mistakes in the stud books as regards coat colors, because color is considered a matter of minor importance by a great many breeders.

SORRELS ARE ABUNDANT

The chestnut by chestnut matings, while few in number, serve to demonstrate that sorrel is recessive to chestnut. In order to conform exactly to Mendel's Law the offspring should be in the proportion of three chestnuts to one sorrel, and they do approach this proportion rather closely, being thirteen to five respectively. There is a predominance of sorrels as compared to chestnut, in the Belgian breed studied, and it would therefore be expected that a larger number of the chestnut animals would be heterozygous for sorrel, than if these two colors were present in equal numbers. This is more clearly shown in the chestnut by sorrel matings. Again considering the matter theoretically, if the two colors were present in equal numbers, there should be fewer sorrels than chestnuts resulting from this cross, but there are twenty-three sorrels to eleven chestnuts. The same thing is brought out in the sorrel by bay matings. The sorrels and bays are present in about the proper proportion, but theoretically, there should be a larger number of chestnuts.

The bay by chestnut matings also substantiate the fact that sorrel is recessive to chestnut. If such were not the case the number of sorrels from this cross would be very small as compared to the others, but the result is twenty-two sorrels, forty-eight bays, eight chestnuts and one black.

The sorrel by black matings give a result similar to the chestnut by black matings. The former gives nine sorrels, eight bays, one roan, one chestnut and six blacks, and the latter, one sorrel, two bays, one brown, one roan, one chestnut and one black, showing that sorrel and chestnut are qualitatively alike. The occurrence of bay offspring from these matings is explained by Prof. E. N. Wentworth[3] in the following way:

"The bay coat results from the presence of two pigments in the hair tubules, viz., red, and black. There is a factor associated with the red pigment which restricts the appearance of the black pigment to certain parts of the body, as the mane, tail, legs and around the eyes. In the case of sorrels and

[3] "Why is a Horse Bay?" *The Horseman*, November 10, 1914.

chestnuts the coat color is due to the red pigment alone, but the restriction factor is also present. Since there is no black pigment present in these animals this factor cannot exert itself until the black pigment is brought into the cross by the other parent, as in the case of black by sorrel matings."

INFORMATION WANTED

One point which might prove of value in determining the difference, if there be any, in the pigment which produces sorrel and that which produces chestnut is this: Are the bay animals from sorrel by black matings lighter in color than the bays from chestnut by black matings? Information pertaining to this point will be gratefully accepted.

The appearance of roan offspring from most of the tabulated crosses, as well as the three bays resulting from the chestnut by sorrel cross cannot be accounted for, except by mistakes in the records as previously mentioned.

The fact that the sorrel by sorrel cross gives sorrel offspring in practically 100% of the cases is rather definite proof that sorrel is a unit character, and further, that it is recessive to all other colors. Therefore, the breeder who is desirous of producing sorrel animals has an easier task than the one who desires to produce animals of a color other than sorrel. The former will be certain of getting sorrel colts as long as he has a sire and dam of sorrel color, while the latter cannot be certain of the results from the cross of any other color. With sorrels becoming rather popular, especially among pleasure horses, this point will doubtless be of some value to those who make a business of producing such animals.

A Magnificent Flowering Vine

Camœnsia maxima, discovered by Welwitsch in tropical Africa, has probably the largest flowers of any of the Leguminosæ. Blossoms produced under glass by the Department in Washington were illustrated in the *American Breeders' Magazine*, IV, p. 212, December, 1913. Robert M. Grey of the Soledad Sugar Co., Cienfuegos, Cuba, who has been growing this vine in the open air, writes: "The clusters of flowers are beautiful, large and the gilt-edged petals appear hand painted. The change of this tracery from gold to brown on the second day is equally remarkable. The aromatic fragrance which can be detected 20 or more feet distant is very agreeable.

"The Camœnsia vine is growing in rather clayey soil with a reddish rottenstone subsoil, on a dry situation, but gets abundant water during our wet season and is occasionally watered during the winter or dry season, but stands considerable drought without injury. It will grow in full sun, also full shade, but makes more luxuriant foliage where partly shaded. Flowers are produced several times annually. I believe the vine could be acclimatized in the hammocks of southern Florida with little or no trouble and the natural distribution of its seeds would cause it to spread rapidly."

Members of this association who are in a position to grow this vine, either under glass or out of doors, can probably secure seed by communicating with the Office of Foreign Seed and Plant Introduction, U. S. Department of Agriculture, Washington, D. C.

Eugenics Research Association

Dr. Adolf Meyer, director of the Phipps Psychiatric Clinic, Baltimore, was elected president of the Eugenics Research Association, at its annual meeting in Cold Spring Harbor, L. I. William F. Blades was continued as secretary-treasurer of the Association.

PHILIPPINE HORSES

First Brought to the Islands from Malaysia—Later by the Spaniards from China and Japan—Direct Spanish Importations Very Late—American Efforts to Improve the Breed

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EVERY visitor to the Philippines has had an opportunity to observe the many good qualities possessed by the native horse, or pony as it is more often called. Despite its diminutive size, it is often seen hitched to a native carretela (two-wheeled vehicle) and drawing a load of half a dozen persons, at a gait of six miles an hour, without regard for the tropical heat.

During a sojourn of seven years in the Archipelago, and experience of every province, I have been much interested in learning the origin of these native horses. Extensive questioning of both Spaniards and Filipinos has brought in every case the same answer, a perfectly natural one, that the horse was first brought to the islands by the Spanish conquerors. Some Spaniards, however, asserted that the native races contained a considerable infusion of Arab or Barb blood, but this was probably little more than a guess, based on the fact that the renowned Andalusian breed contains much of that blood, and might well be supposed to have been brought to the islands from Spain.

Study of evidence from many sources has convinced me that the common opinions are largely erroneous, and the object of the present paper is to cite in chronological order the data which I have been able to collect, to show exactly what the Filipino horses are, from a genetic point of view.

With reference to the introduction of horses, Philippine history may be divided in four periods:

1. The period when horses were altogether unknown to the inhabitants of the archipelago.
2. The period of first introduction of the horse, with the Malay migrations from the Malay Peninsula and Sumatra to Sulu and Mindanao.
3. The period of Spanish occupation.
4. The period of American occupation.

Evidence that the horse was unknown to the aborigines prior to the Malayan invasion depends on the fact that every wild tribe in the islands (except the Muhammadan tribes) knows the horse only under the name of *kabaya*, a corruption of the Spanish *caballo*. Had the horse been known to them before the Spanish conquest, they would certainly have had a native name for it.

The evidence that horses were brought to some of the southern islands, at least, by the Malay invasion, is pieced together from a number of different sources, the Moro chronicles being too brief to afford much information. I shall present the data and allow the reader to decide whether or not it is adequate to support my position.

NATIVE NAMES FOR THE HORSE

In the first place, we know that the Moros—the Muhammadan peoples of the south islands—were familiar with the horse, because they have names of their own for it: *kuda* (Sulu) and *kura* (Magindanao).

Turning now to the history of Sulu, we read of the period of Malayan invasion: "Two prominent characters which mark the era are Makdum and the Rajah Baginda. Makdum was a prominent Arab judge and scholar who arrived at Malacca about the middle of the fourteenth century and converted the ruler, Muhammad Shah, to Islam. . . . Continuing farther east he reached Sulu and Mindanao about 1380."

THE SULU PONY IS THE OLDEST TYPE

Long before the Spanish conquest, the Muslim tribes of the southern Philippine Islands had horses, which apparently came from Sumatra. The stock is still fairly distinct from that of the northern islands This photograph shows a good specimen of the breed, with Sulu rider. The bridle is the last word in simplicity. (Fig. 11.)

Some time after Makdum (the Genealogy of Sulu says ten years) there came to Sulu a prince from Meningkabaw. This is a rich, high region in central Sumatra, from which many Malayan dynasties seem to have come. The first historic seat of Malay rule was Pagur Ruyong (in the mountains of Sumatra), the capital of the so-called empire of Meningkabaw.[1]

Five years after the arrival in Sulu of the Rajah Baginda, from this Sumatran region, the rajah of Juwa sent a messenger to Sulu with a present of wild elephants. We are informed that the messenger's name was Juya, that he

[1] Malay-English Dict., R. F. Wilkinson, III, 2.

MANY CHINESE CHARACTERS VISIBLE

This pony, photographed at Batangas, P. I., shows many of the traits which are found in the horses of China. It is learned from old records that the Spaniards, after they captured the Philippines, introduced many horses from China and Japan, which have helped to make the stock of the islands the complex mixture that it is today. (Fig. 12.)

died at Ansang, and that only two of the elephants survived in Sulu.[2] I mention these facts to demonstrate that the Rajah Baginda was a prince of some importance in Malaysia, and that there was communication between him and rajahs in the older region.

The next arrival on our scene is Abu Bakr, a learned Muhammadan jurist who is supposed to have been born in Mecca, and to have lived in Malacca and Johore for some time, proceding eventually to Sulu by way of Sumatra and Brunei. He founded in Sulu the dynasty which was reigning at the time of the arrival of the Spaniards, June, 1578.

Examining the information furnished by the early Spanish chroniclers,[3] we read: "Cinnamon, ginger, myrobalans,[4] oranges, lemons, cucumbers, gourds, chickens, geese, deer, elephants, horses and other things are found there."

The statement that horses existed in the Muhammadan islands of the Philippine archipelago is substantiated by the report of Don Esteban Roderiguez de Figuerosa to Governor Sande in June, 1578: "These Moros are most dangerous people, being familiar with all manner of firearms and with horses."

The foregoing evidence makes me feel confident that before the discovery of the islands by Europeans, the natives

[2] Ms. chronicle belonging to Hajji Butu, prime minister to the Sultan of Sulu.

[3] "First Voyage around the World," by Antonio Pigafetti (1519–1522).

[4] Probably the fruit of *Phyllanthus emblica* L. This Indian product enjoyed anciently a great reputation; modern pomologists who have eaten it consider it nearly worthless.

of Sulu and parts of Mindanao possessed horses, and I have shown that these animals might easily have been brought by powerful Malayan princes as early as the fourteenth century.

THE MALAY IMMIGRANTS

But as to the exact origin of the animals, we cannot say with certainty. The records of Sulu assert that even before the arrival of the rajah Baginda from Sumatra, the trade of Sulu extended to Japan and China on the one side, to Java and Molucca on the other. Large numbers of natives of Celebes are asserted to have migrated to Sulu and been assimilated by the people there. Furthermore, a large part of the Malayan region acknowledged the supremacy of the Mongol conqueror Kublai Khan, and some of his followers might have been responsible for bringing horses to the Philippines. Again, vast hordes of people from Johore are said to have migrated to Sulu early in the fourteenth century, and might easily have brought the animals with them.

Thus it will be seen that there are two possible sources from which the first horses might have come to the Philippines: Malaya, or China.

In favor of a Malayan origin is the fact that the bit used by the Moros is not only entirely different from that of the Spaniards, but is also dissimilar to any Chinese or Japanese bit which I have ever seen. Whether it is like those now used in Malaya, I am unable to say.

But it requires no strain of credulity for me to think it probable that horses were first brought to the Philippines from Sumatra, or one of the neighboring islands.

If we accept, as it seems to me we must, the idea that the Sulu horses are from some part of Malaya, it seems to me most probable that they came from the same place the Sulu people did—namely, Sumatra. It is possible that they have later had an infusion of blood from Celebes, or indeed from other sources.

Investigating the modern breeds of Sumatra and Celebes, we learn from Hans von Barnekow that there is a breed called the Balak, which in usefulness excels all others. Its home is the high plateau of Sumatra, especially the shores of the great Toba lake. In conformation it is handsomer than any other of the native breeds, and is as good under the saddle as for cultivating. All other horses of the western coast of Sumatra are known under the collective name of Bovenland, although they vary a good deal in build and value; they are heavier than the Balak but do not equal it in utility.

The Celebes horse is now generally called the Macassar and although small and not beautiful, is hardy and strong. Its owners have long been distinguished above all other residents of the Malayan region, for skill in horse breeding.

I am inclined to believe that the Sulu horse represents the Batak, with perhaps some intermixture of Macassar and Bovenland blood.

These horses of the Moros never seem to have become known in the northern Philippines. We must next consider the origin of the horses found in Luzon and other northern islands.

THE HORSES OF LUZON

The discovery of the Philippine archipelago by Magellan marks the opening of a new chapter in the history of the Philippine horse, which was no longer to be the exclusive possession of a few Muhammadan tribes in the extreme south.

It might have been supposed that the natives of Luzon and the Visayan islands would have received the horse from Chinese traders who constantly visited them. But we are assured by the Chinese historian Chua Juka that his countrymen only skirted the coasts of the islands, and had no direct communication with the interior of the islands. The Spaniards, however, considered the horse a necessity: an old manuscript relating to the expedition of Villalobos, which left Acapulco, Mexico, in 1530 to proceed to the Philippines, mentions the commander's order that those who take horses may take two Indian slaves apiece.

If any horses were taken, they must

AN IGORROT PONY

The natives of Benguet province have many ponies, but due to lack of care they have in many cases degenerated to scrubs. This photograph, taken at Trinidad, Benguet, shows the average native pony of the district. The position of the rider's foot in the stirrup is particularly striking to an American horseman. (Fig. 13.)

have perished, as Governor Sande's relation (1576) remarks that the governor on his walks always went afoot, "as there were no horses." From the same source we learn that in the year 1576 a Chinese called Omacon appeared off Pangasinan, being in command of a ship that was searching for a pirate named Limobon, whom he found there. He had the good luck to discover that the Spaniards had already met and defeated this pirate.

The captain had brought with him, as present or for trade, thirteen horses, which the Spanish chronicler describes unflatteringly—"These beasts are full of bad habits like those of Galicia."

The above fragmentary records are all I have been able to recover concerning introduction of horses during the first years of the Spaniard's possession of the islands. But the trade quickly took greater proportions. In 1583 the general junta at Manila made a

memorandum, "That the buffalo (carabao) be domesticated, and that his majesty should give imperative orders that an effort be made to have many cattle and horses brought from China and Japan."

A letter of Santiago de Vera to Philip II, dated June 26, 1587, states, "Many vessels have come to these islands from China this year, and especially to this city more than thirty of considerable burden, laden with a quantity of merchandise, horses, cows and more than 3,000 men." In the relation of events for the following year, 1588, we read, that many horses and cows have been brought from China to Manila.

That the effort of the colony to introduce and distribute horses met with the approval of the king, is evidenced by his instructions to Gen. Dasmarinas, dated August 9, 1589: "Cattle and horses are to be sent to the islands, and the farmers sent shall be ordered to tame and breed the wild buffalo found there."

These positive orders evidently bore fruit. As early as 1604 Cherino says, in his relation of events from 1601 to that date: "But they (Chinese) have stocked the islands with horses and mares which have since multiplied, and great stock farms have been established."

Production seems to have outrun demand, for Viana in his memorial of 1761 reports that although there are many horses in the islands, "there would be more if the ranchmen had a better sale for them. They are accustomed to kill them in order to dry their flesh and sell it."

To sum up, we find that as early as 1751 the horse had, through the activity of the Spaniards, become introduced and distributed in the northern islands; and that these horses were not from Spain, as has been ever since taken for granted, but that they were from China.

CHINESE HORSES

When we try to ascertain the ancestry of these Chinese horses, we meet with little success. It is known that they were domesticated in the Flowery Kingdom at a very early day: a hymn ascribed to the Yin dynasty (1766-1122 B. C.), describing the emperor's horses, mentions thirteen different colors. All black horses had to be turned over to the monarch.

In trunk and limbs the horses of Korea and Mongolia bear a close resemblance to that wild Siberian breed known as Prjevalsky's horse, and to the semi-wild Tarpan from the same region, and it may well be that the Chinese horses in general are of northern origin.

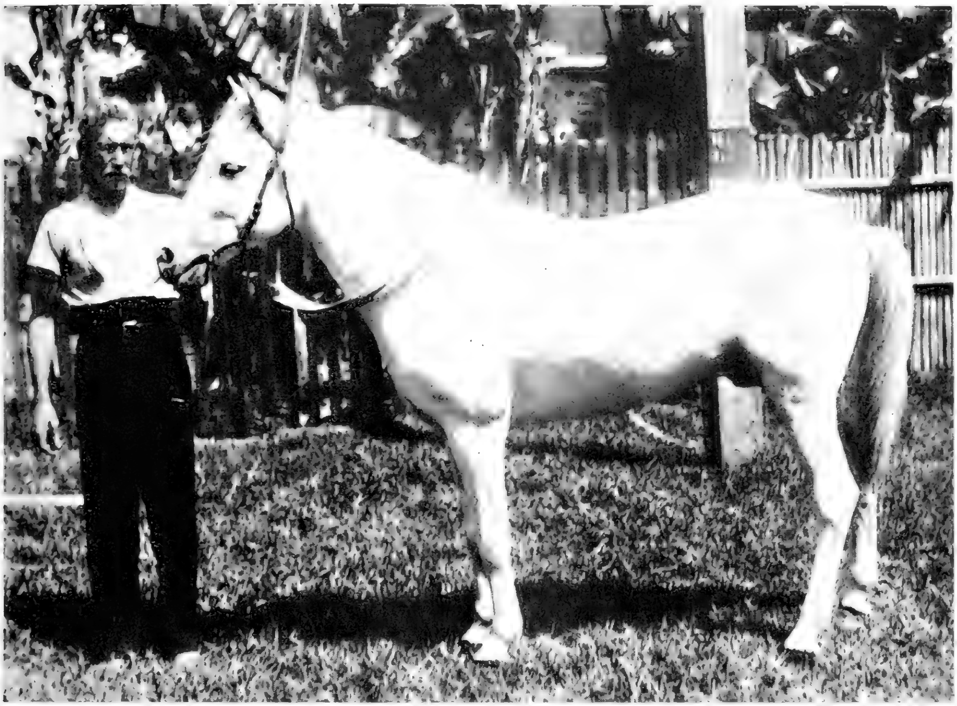
It is natural to suppose, and is demonstrated by such facts as we have, that the horses brought to the Philippines were from the southern provinces of China. Even today the resemblance between the breeds in these two regions is close. The Mongolian horses which I have seen are coarser than these south China horses and the still smaller Philippine ponies.

It will be recalled that the orders of King Philip II directed that horses be brought from Japan as well as China. The first record of importation from Japan is in a letter to the monarch from Santiago de Vera, dated June 26, 1587. "In a former letter," he writes, "I informed your majesty of the arrival of a Japanese vessel laden with flour and horses (which they are bringing to this city), at the town of Segovia in the province of Cagayan in these islands." This is the most northerly province of Luzon. "They had been driven ashore upon the coast there and some of the crew and horses escaped."

Again in a letter to the king from Governor Tello, dated June 17, 1598, we read, "After this the ambassador was invited to dine with the [ruler of Japan] three times and was finally dismissed with a present of twelve coats of mail, thirty lances and two horses."

The most lucid and concise description available relative to the trade in horses is that by Dr. Antonio de Morga, which follows:

"There were no horses, mares or asses in the islands until the Spaniards had them brought from China and Japan, and brought them from Nueva



THE PHILIPPINE HORSE AT ITS BEST

From the mongrel stock of the Philippines, representing breeds of all parts of the world, some good strains have been isolated, and when care is used, ponies can be produced which for local conditions are excellent. The horse shown above illustrates a good type produced in the Northern islands; although the animals are small, they are hardy and very capable. (Fig. 14.)

España (*i.e.*, America). Asses and mules are very rare, but there are many horses and mares. Some farms are well stocked with them, and those born there (mixed breeds for the most part) turn out well: they have good colors, are even tempered and willing to work, and are of medium size. Those brought from China are small, very strong, good goers, treacherous, quarrelsome, and bad tempered. Some horses of good colors are brought from Japan. They have long, well-shaped bodies, thick hair, large fetlocks, large legs and front hoofs, which makes them look like draft horses. Their heads are large and their mouths hard. They run slowly but walk well and are spirited and of much mettle."

From the above, I think we are justified in concluding that a considerable number of Japanese horses was brought to the Philippines, first and last. It may be worth while to try to fix the exact breed of these.

There are four recognized breeds of horses in Japan: the Hokkaido, Nambu, Miham and Satsuma. The description of the Nambu given by Sawamura Makoto[5] convinces me that the horses taken to the Philippines were of this blood. He says:

"The Nambu breed is easily distinguished by a thick, low neck and long, slender body. The croup is narrow, short and sloping, and not well developed. The legs are short and rather heavy while the articulation is somewhat weak, the hoofs being large and flat. Owing to the poorly devel-

[5] In the *Journal of the International Institute of Agriculture.*

oped muscles the gait is not very quick or light. The height is from 4 ft. 7 in. to 5 ft."

In a conversation about Japanese horses Professor Fujita, who formerly occupied the chair of zoology at the Imperial University of Tokyo, informed me that the Nambu is the best horse produced in Japan today, as well as one of the oldest and purest breeds, foreign blood not being desired by its owners.

In connection with this breed, I wish to call attention to the horses sometimes met with in our provinces of Cagayan, Isabela and Ilocos Norte. These individuals show in a marked degree the characters above-mentioned. I recall particularly a horse seen in Cagayan province in the year 1910, which one would have felt certain was a Japanese importation. Inquiry brought out the fact that not only he, but his sire and dam as well, had been born and raised in the town.

It would seem, from the information available, that the importation of horses from Mexico met with many obstacles. In his instructions to Dasmarinas (August 9, 1589), Philip II advised him that he was writing the governor of Nueva España to send to the Philippines twelve mares, two stallions, twenty-four cows and two bulls, and Dasmarinas was requested to take these with him. On May 25, 1596, Governor Tello was advised by the king of a similar order to the viceroy of Nueva España, but in the following year the governor reported that the animals had not been received. The first actual evidence I have found of the presence of Mexican or Spanish horses in the Philippines is the letter of Fray Gregorio de la Cruz regarding an expedition to Camboja (now French Indo-China). Under date of August 1, 1595, he acknowledges receipt of a Castilian horse which together with some hunting dogs and emeralds was being sent to the king of Siam as a present. Aside from one or two hints of this sort, there is no record of the introduction of horses from Mexico during the first century of the Philippines, and it is my belief that not until later were they introduced in such numbers as to exert much influence on the industry in the islands.

The ancestry of any horses brought from Mexico can be confidently traced to the horses brought there from Spain by Cortez, Coronado, and other early explorers; for it is well known that the horse did not exist in the New World prior to the arrival of Columbus.

SPANISH HORSES

The original horses brought to Mexico were certainly not, as most people suppose, of almost pure Arab or Barb stock. The Spanish horse of the fifteenth century had been subjected to a long process of cross-breeding. Because of the weight of both armor and rider, the Spaniards had felt the necessity for a heavier horse than either the Arab or the Barb, and therefore introduced German blood.

The story of this cross and its effects may be graphically studied in the museum of paintings at Madrid, in the paintings of Rizzi, Bartolme, Gonzales, Paret, Goya and others. Horses in the later paintings, such as those of the Duke of Zaragosa and Charles IV, have oval heads like those of sheep, while as early as the middle of the fifteenth century the type of the Andalusian was that of a Germanic race. This process was probably largely influenced by Charles I, himself a German.

Thus it is evident that the Spanish horse had lost much of its Arab or Barb blood before introduction to America. Just what blood had entered is not known; but as most of the large West European races contain a greater or less degree of Norse blood, there is ground for assumption that whatever race was utilized contained some of that blood. Norse horses were mostly dun colored with black points. The mane is long and heavy and falls to both sides with a longitudinal dark band connecting the mane and tail. Distinct dark bars are also present, especially in the region of the knees and hocks. The ears are short and carried in an upright position. The outline of the face becomes convex

near the muzzle and ends in a rather long upper lip.[6]

It is to this crossing that the dun (buckskin) color which is not uncommon in Mexican horses may be attributed. In the Arab this color is practically unknown, as for more than 2,000 years all horses of this color and cream color (albino) were held to be fit for no free man to ride. So by constant selection the colors were eliminated.

Reviewing other sources from which horses were brought to the Philippines, we find in a report dated 1620, entitled "Prizes for Oriental Products," that "From Ormuz which is in Persia they bring excellent horses and find carpets." Viana's Memorial, 1751-1765, states: "From Vengalu (Bengal), the Coromandel and Malabar coast and other parts of India they bring sulfur, birdsnests, cotton, rice, gold and horses." This information is important in that it brings into the native horse two lines of descent from a quarter least expected—viz., the Persian Gulf Arab and some unknown Indian breed.

The importation of horses from Persia probably accounts in a certain degree for the strong resemblance between certain Filipino horses and the Arab.

During the latter part of the nineteenth century many Spanish stallions were brought to the islands, to improve the native stock.

AMERICAN BREEDING

This brings us to the American occupation in 1898, when a new element enters. The Bureau of Agriculture has established stock farms and maintains blooded stallions in various provinces. These animals are at the service of the public *gratis*. Among the breeds used are the Arab, Anglo-Arab, Gulf Arab, Morgan, Kentucky, Standardbred, selected native, and grades. It is too early to foresee the final result of such a mixture. At first the desire seemed to be to produce a fast animal that would bring a high price on the race track, but a ruling that half-breed horses must be entered as such, checked this tendency. At present the natives are very slow in taking up the improvement of their horses. Much promiscuous breeding of inferior stallions takes place, due to the fact that castration is not practiced; and it is my belief that no great improvement can be made in Philippine horses until a stallion tax or other restrictive measure is passed, which will prevent this.

Reviewing the horses I myself have seen in the various provinces, I find five fairly well defined types, not counting the various half-breeds and mestizos or scrubs. It should be said that there is almost every possible gradation between these types. Nevertheless, the types are distinct—anatomically, and not by geographical lines. They are:

1. A type which favors the Arab in many points. The head is sharply chiseled, though not dished as in the Arab; eyes large and lustrous; ears well placed, normal and mobile; head well attached, neck rather thick, well curved and graceful. Chest as a rule full and well developed, though sometimes narrow. Withers full, hindquarters developed to a sufficient extent, tail gracefully placed and carried with vigor. Croup regular and compact. The rump, withers and hindquarters are remarkably strong. Both fore and hind legs are clean-cut, free and muscular, with good articulations. The hoofs are generally oval, black and hard, though there is sometimes a tendency to mule-foot. Mane and tail full. It is needless to say that individuals of this type have been produced by more or less careful breeding and are therefore most plentiful in the provinces that have been longest settled.

2. A type that favors the Chinese horse. Individuals are generally rather short (49 or 50 inches) but thick-set. Head heavy though not noticeably long, nose flat, nostrils rather full, lower jaw powerful, forehead and face rather narrow, profile more convex toward the muzzle, ending in a somewhat long upper lip. In neck, shoulders and trunk they resemble a small cart horse. Hindquarters are full and rounded and tail well placed, although there is slightly more slope to the croup than we generally desire. Hind legs are fairly long with hocks close together, often cow-hocked, hoofs vary but generally oval, black and hard, though sometimes narrow. Mane heavy and full, falling on both sides; tail long and full.

3. In the third type are most of the horses of the islands, particularly in the rural districts. They vary around 48 or 50 inches high, with medium head, well chiseled and placed, profile straight, neck gracefully curved, chest rather

[6] J. Cossar Ewart, "Multiple Origin of Horses and Ponies."

narrow, croup sloping, legs clean-cut, hoofs oval, black and hard, articulations good. Tendency to cow-hock. Mane and tail not very full, although the prevalent custom of roaching the mane and clipping the tail makes it hard to decide.

4. Another type, found mostly among the non-Christian tribes, is a small, stunted animal, the result of promiscuous breeding, poor food and little care. These animals seldom stand over 4 feet high—many will come within 45 or 46 inches. They are mostly dun colored, rough coated; face narrow and sometimes inclined to that configuration which is called hatchet-face. They are inclined to be ewe-necked; chest narrow and weak, croup narrow and often sloping, hindquarters weak, rather cut legged and cow-hocked. Mane is short and bushy, having the appearance of being roached even when it is not; tail similar. The only redeeming feature in these horses is their hardiness and ability to exist on mountain grasses and other non-nutritious roughage throughout the year.

5. The fifth type, not often seen, resembles the Nambu breed of Japan. The head is heavy and long with straight profile, neck straight, body long and slim, withers prominent, croup narrow and sloping, legs heavy with well-developed fetlock, front hoofs quite large and round, mane full and falling on both sides, tail full and long.

The horses of Sulu and part of Mindanao might be considered to be a still different type, having, as I showed, a distinct ancestry. Their heads are broad with forehead inclined to be bumpy, ears rather long and set obliquely on the head, eyes large and far apart, neck thick, chest and shoulders well developed, withers strong but not prominent; profile straight, almost dished; muzzle square with large nostrils, body moderately long, croup sloping but not narrow. Hocks well placed together but not cow-hocked; legs rather short, hoofs oval, well-formed and hard.

In color there is every possible variation, throughout the islands, but buckskin largely preponderates. There follow, in order, the bay, gray, piebald, black, and a good many albinos. In a census taken by the writer on one island, Catanduanes, where there are more than 3,000 horses, between 55 and 60% of the horses were of the various shades of dun, varying from fallow to mouse.

CONCLUSION

In conclusion, I have endeavored to prove that the Philippine horse is not, as popularly supposed, a descendant of horses brought to the islands from Mexico and Spain by the Spanish, but that the bulk of the animals brought in by the early colonists were Chinese. I have also shown that horses existed in parts of the archipelago prior to the Spanish conquest, and I have endeavored to trace the ancestry of these to Malaya. I have pointed out that, in addition to China, other channels hitherto almost unknown have poured equine blood into the Philippines; so that the horses of the islands today contain large or small amounts of characters from the Chinese, Japanese, Mexican (including various races entering into the race so designated), Persian, Indian, Sumatran breeds.

The data furnished have been obtained from the following sources:

The Philippine Islands, by Blair and Robertson; a translation of the manuscript of the Archives of the Indies, at Madrid.

History of Sulu, by M. M. Saleeby; based on original MS. (known as the *Luntar*) obtained from the Sultan of Sulu, and the Genealogy (*Tarsila*) of Sulu, obtained from Hajji Butu, prime minister to the present sultan.

Archives of the executive bureau, Manila.

I am particularly indebted to Dr. Saleeby for information personally furnished.

New Oat Varieties for Maine

After five years of selection, the Maine State Agricultural Experiment Station has isolated twelve pure lines of oats which it considers particularly valuable for local conditions. They are described in Bulletin 250 (May, 1916), the introduction to which gives an interesting account of "pure lines" and the general principles governing cereal breeding in the light of genetics.

RASPBERRY BREEDING IN NEW YORK

THE breeding of raspberries at the Geneva, New York, state agricultural experient station was begun nearly a quarter of a century ago. At first the work was largely confined to the red raspberry and a number of excellent seedlings were secured from various combinations of Marlboro, Loudoun and Superlative. Since 1910, greater attention was paid to the black-cap and purple raspberries. About 3,300 seedlings were tested.

It was to set at rest any doubts which might remain as to the hybrid origin of the purple raspberry, Peck's *Rubus neglectus*, and to secure better varieties of this popular sort, that the breeding of purple raspberries was undertaken. The work has shown beyond a doubt that these originated as hybrids of the black-cap and red raspberry. Some very promising seedlings have been secured.

Pure seedlings of Columbian and F_1 hybrid, failed to break up as much as would be expected. None showed any tendency to propagate by suckers nor did any have fruit of the color of either parent. In cane color and glaucousness some of the seedlings more nearly approached the parent types.

Hybrid seedlings were produced by crossing two black-caps with a red raspberry. With one cross the seedlings were all purple; among the 289 seedlings of the other cross were ten yellows. None progated by suckers.

A study of the inheritance of color of fruit would indicate that several of our black raspberries are heterozygous for color and that probably several color factors are present. The same thing holds with the red raspberry though the higher number of yellows would indicate fewer color factors. Selfed seedlings of Columbian gave one yellow, one black and forty that were probably varying degrees of purple. A black-cap which was pure for color produced only purples when crossed with a red containing a factor for yellow, but when both were heterozygous yellow hybrids were produced.

Glaucousness, the presence of bloom on the canes, is probably a dominant character. Both the Columbian seedlings and the F_1 hybrids gave glaucous and non-glaucous bushes in a ratio very nearly three to one.

The F_1 hybrids could also be separated in the ratio of three with rough bark to one with smooth bark.

Three of the Columbian seedlings produced some unusual abnormalities in the flower clusters. There were many gradations from perfect fruits to those in which the drupelets were replaced by small, sepal-like leaves. In other clusters the fruits varied from perfect to entirely sterile forms which did not have the leafy growth.

All the purple raspberries having Smith No. 1 as the female parent were standard plants but nearly one-third of the Cumberland seedlings were dwarfs. The factor for dwarfing is evidently one of rather rare occurrence.

From a correlation which was found between leaf coloration and fruit it would seem that it is entirely possible to tell all yellow raspberries from either the red or purple sorts by the absence of any tinge of red on the leaves. It is probably true also that the bark of the young canes of the yellow varieties is entirely lacking in any touch of red or purple color.

The Herbert red raspberry and the Blowers blackberry were pollinated by the flowering raspberry, *Rubus odoratus*. The Blowers seedlings were lacking in vigor and all died the first year. The Herbert seedlings made a strong growth and in 1915 blossomed freely. A study of these leaves no doubt as to their hybrid origin. In *Rubus odoratus* we may have a go-between through which we may mix the blood of several of our species. This work of hybridization will be continued with many other species, of which there are now nearly fifty growing on the station grounds. —Summary of Bul. No. 417, "Some Notes on the Breeding of Raspberries," by R. D. Anthony, under the direction of U. P. Hedrick, March, 1916.

The Journal of Heredity

(Formerly the American Breeders' Magazine)

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CONTENTS

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WHEN THE BABY LEARNED TO WALK

She was adopted, at the most interesting age, by a girls' camp, and she taught the girls more about Mothercraft in a few weeks than they would have learned in as many years of the ordinary domestic science curriculum. Her first efforts at locomotion particularly excited wonder. Photograph by Mrs. Luther H. Gulick. (Frontispiece.)

BABIES IN THE CURRICULUM

Education Given Girls in Separate Colleges Dwarfs Instead of Developing Their Emotional Nature—An Example of Natural Education That Was Successful

A. E. Hamilton,

Interlaken School, Rolling Prairie, La Porte County, Indiana

OUR Women's Colleges are on the defensive. The wide press publicity given to the Journal of Heredity articles[1] on the low marriage and birth rates of graduates from women's colleges drew broadsides from many quarters. College deans, professors, alumnae and students fired inky eloquence at the eugenicists' thesis, but nowhere do they seem to have hit the real issue a telling shot. Miss "Alumna, A.B.," speaking a whole page of *The Ladies' Home Journal*[2] at several million readers, for instance, says that college does not unfit a woman for motherhood, nor does it drown the desire for wifehood and motherhood, nor in any way make a girl fundamentally less a true woman. She says the reason she never married is because she was never asked, and the principal reason she was never asked is because young men thought themselves economically unable to support her and preferred marrying a girl outside their own social set to waiting until their salaries could foot the supposedly necessary bills. She quotes her own brother as saying:

> "We brand our love with a dollar sign. We're all slaves of *front*. That's the reason young men in our set don't marry young girls in our set. They think they can't support them. They think the girls think the same thing. So they pick out a girl to whom $25 a week looks as big as $50 looks to you."

She regretfully cites the fact that working girls in her own community are marrying the men in her own college set, attributing this to economic considerations only, and saying, of these men:

> "Nearly all the men calling on me were making small salaries, with larger salaries ahead, far ahead. I wondered if they held the same views that Tom held. As for my views, none of them ever gave me a chance to state them!"

Now in that last sentence lies the crux of the whole matter. In our co-ed colleges, like the University of Wisconsin, for example, young men and women have a fairly wide range of opportunity for finding out each other's views. They get used to talking about things that do not ordinarily crop up in drawing room conversations in the post-college social world. They discuss present affairs, and what they will do with themselves afterward. They live on a fairly democratic plane where economic differences are largely levelled. Courses in biology, sociology, psychology and political economy break the ice for individual and collective talkings about marriage, divorce, parenthood and even eugenics as though they were living issues instead of esoteric mysteries or uni-sexual affairs.

In our exclusive women's colleges girls grow up in a traditional atmosphere of femininity heavily tinctured with a fossil "culture" that is only beginning to be modified by the present-day and practical. That nature has built a goodly number of women in such a manner that they survive living for four years in this medium and bring their womanliness through unscathed

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[1] Johnson, Roswell H., "Marriage Selection," Journal of Heredity, V, pp. 102–110, March, 1914. Johnson, Roswell H. and Stutzmann, Bertha J., "Wellesley's Birth Rate," Journal of Heredity, VI, pp. 250–253, June, 1915. Sprague, Robert J., "Education and Race Suicide," Journal of Heredity, VI, pp. 158–162, April, 1915.

[2] June, 1916.

is providential but not to the point. What happens is that a host of them, and probably this is true of those unmarried ones of whom the Johnson and Sprague statistics speak, fail to carry away with their diplomas that obvious, though subtle and intangible something that makes a young man say to himself:

> "There is a girl I can chum with. I can talk with her freely about almost anything without an irritating feeling that I ought to be discussing woman's rights, or that she suspects me of ulterior and far-sighted plans against her self-sufficient solitude."

The Johnson and Sprague figures talk of that unconscious encrustation of intellectual primness, that palpable and reserving something that is almost bound to appear on the surface of a girl who has spent four of her very best years in nunnish isolation from young men of her own caliber, and from the world-old influences that stir and keep alive the root affections of womankind. This carapacing may be only partial, or it may be almost complete, and it is undoubtedly far below the girl's own consciousness as one's more characteristic mannerisms are apt to be, **but the fact remains that in many cases at least it is enough to account for that "not being asked" that is attributed to to economic and other causes.**

It may be that the very fact of having been through college casts a fine net of difference about a woman, holding some young men aloof. It may be that a college course connotes some degree of wealth and, by implication, ideals of material living higher than most young men can immediately obtain. It may be that choosing a career is taken to imply that a young woman prefers that course to marriage. It is probably true that all these causes, together with the fact that some of our young women suffer at least an outward dessication of essentially feminine qualities, help roll up the damaging statistics. The story they tell, however, remains the same. The marriage rate of graduates from women's colleges is strikingly below par.[3]

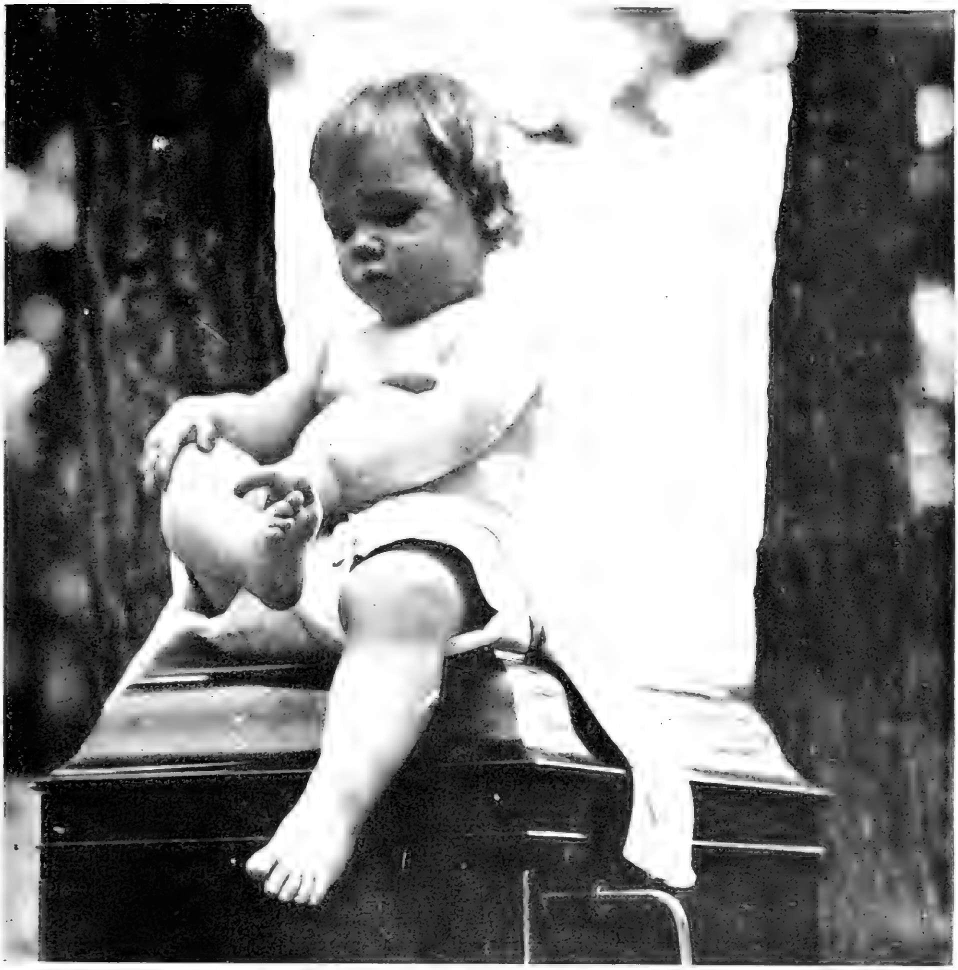
WHERE ARE THE BABIES?

And as for the drive at the spirit of the curriculum, a glance at even those of our colleges for "domestic science" will amply prove the contention that they are pretentiously superficial and dustily intellectual. There are rows of little gas stoves over which prospective wives conduct culinary chemical experiments. There are courses in biology, something of physiology and hygiene, the art of interior decoration and the science of washing clothes. There is text-book sociology and sometimes lectures on heredity or eugenics. But the smile of incredulity as to my seriousness when I asked the principal of the Margaret Morrison Carnegie School of Domestic Science, "Where are the babies?" is typical. Babies were impossible. They would interfere with the curriculum, there was no time for practice with babies, and besides, where could they be got, and how could they be taken care of? The students were altogether too busy with calories, balanced rations, and the history of medieval art.

But when I asked where the babies were, I did not have in mind the necessity for learning how to feed an infant or how to strap it in a perambulator. I was thinking of what a baby could mean in the life of a young woman who looked forward to home-making, of the rôle it would play in the education of her true self, not merely of her memory for facts.

It was astounding to think that there was actually no place in America where

[3] Briefly, less than half of the graduates of the principal women's colleges marry, and they bear not more than two children apiece—a number so small as to ensure a rapid disappearance of their section of the race. The record of honor graduates, who may be presumed to represent a particularly select lot of families, is even worse than that of the graduates as a whole. The non-collegiate sisters, cousins and friends of these graduates have a better record, although they come from the same social class and are subject to the same influences, except for the college course. This indicates that it is actually the college course which keeps girls from marriage and from making an adequate contribution to the next generation. The record of the girls in the coeducational colleges is also better.



HER FINGERS WERE TAUGHT NOT TO SCRATCH

They learned to stroke softly and gently instead. It was one of the first and most important lessons given her; and it was equally important for the young girls who looked on. Photograph by Mrs. Luther H. Gulick. (Fig. 1.)

a young woman could go who wanted really to learn mothercraft, the craft of the heart as well as of the head.[4] To be sure Mary Read had been working in New York for five years trying to make the weight of her small school felt, a school where babies played a big part in the scheme of things and where, although the letter was a bit schooly, the spirit was lively and fresh. The Little Mothers' League had been quietly at work getting girls and babies together in a sometimes very happy fashion, and the program of Camp Fire Girls included a goodly round of baby-craft and home-craft honors. But at Morrison Carnegie, at Simmons, at Bryn Mawr, at a score more higher schools for women, there were only text-books and gas ranges and lectures and examinations.

I was privileged, however, to witness

[4] In New England there is a school for this purpose which is, in many ways, excellent. But the students are never allowed to see a baby; they handle only a big doll! A live baby is impossible, we are informed, because its presence in the class would make the girls giggle. It would be interesting to know how many graduates of women's colleges have failed to find mates because their instructors had eradicated from them the ability to giggle, together with all the freshness and spontaneity of the feelings which giggling denotes.

SOMETIMES SHE PADDLED IN THE LAKE

But her nights were apt to be a bit restless after such experiences—another lesson in Mothercraft for thirty young girls. Photograph by Mrs. Luther H. Gulick. (Fig. 2.)

an incident during an eight weeks' visit to a summer camp for girls that raised my hopes concerning the future of education for American young womanhood. I will sketch, briefly, some of the things that I saw. Most of them centered in Janet.

Janet scratched. She would double up her little fist into a taloned claw and, quick as a flash, it would shoot straight out for one's nose or cheek and scratch with all its might. An impish, hard, unlovely look came over her sweet baby face when she did this thing and Hiiteni, the Camp Mother, wondered how the habit could be stopped, for in every other way Janet was the gentlest and happiest of infants. So Hiiteni watched for the first symptoms of that cat-like stroke, and when the fingers began to double into claws, she seized the little hand and drew it over to her face, placing it against the cheek gently, drawing it downward softly and saying: "Nice, nice, nice." In two or three days the old habit had been replaced by the new. Janet would look up rougishly, reach out toward nose or cheek again, but touch gently, softly with a downward love-stroke. Later she learned to say

THE LITTLE IRON TUB WAS SAFER

It was warm on the rocks, in the sun, and she enjoyed it almost as much as the lake. Photograph by Mrs. Luther H. Gulick. (Fig. 3.)

"ice, ice, ice" as she stroked a face with her hand and smiled the happiest of baby smiles.

MOTHERING JANET

And all this time the girls watched—thirty of them, young girls from well-to-do homes who had come to camp for the summer. They were there for a good time. Their days went to paddling in canoes, swimming and diving in the lake, hiking on the country roads, sleeping out under the stars in the woods, tenting on the huge grey rocks, sewing, weaving, wood-blocking, decorating diaries and paddles, canning fruit, making dishes and mugs of clay, and—mothering Janet.

Two by two the girls cared for the baby every day. In pairs they watched her wake in the morning, bathed and weighed her. They brought her to the long table where she learned to hold a mug and drink from it, learned that some plates are hot and some are cold, and that girls at camp are very tuneful and very noisy. Two by two they washed Janet's clothes, hung them to dry and brought them in. Two by two they watched Janet at play and took her off to dreamland.

Hiiteni, the Camp Mother, watched her girls mother Janet, guided, controlled, suggested each day, but never preached and never let those thirty young girls feel that they were in school, learning most important lessons. The girls learned what was good for the baby to eat, and to wear and to feel (for when she was allowed to paddle for ever so little a while in the lake, her night was restless, and so she was treated to the

warmer waters of her small iron tub). One of them wrote a "tub song" for the morning bath:

Splash, splash on Janet's toes,
Tweek-tweek, Janet's toes,
Janet's eyes, blue, blue,
Janet has two pink ears, too!
Baby's mouth, round—so!
Pearly teeth, all in a row.

They watched the baby's every move, saw her grow day by day, saw the plotted curve of the weight chart go up, slide down, rise again, but always reach a higher point at the end of a week than the place where the week had begun. In their journals they recorded some of the things they saw, and they built a Baby Book of Janet's doings. Sometimes in prose, sometimes in verse, they set the doings down.

Janet loves to creep along,
Beside a little bug,
And pinch it with her fingers,
Or squash it on the rug.

I've seen her take a flower
And press it to her nose,
And, in attempt to smell it,
Janet merely blows!

Have you seen Miss Janet,
Watch the sunshine chase
The shadows in the morning
From their hiding place?

The girls read their observations at the weekly council fires on Monday night. Sometimes they merrily pantomimed the care of Janet, and the lessons in baby craft that they had learned. They called the baby "Moon-Child" and invented special honors, to be won by all who did things for Janet in a systematic way. For each girl wanted to mother the baby, and organization by turns was necessary for the youngster's welfare. Therefore the two by twos.

Janet was the hub of that camp. The curriculum, if the happy freedom to keep busy as one chose could be called such, was moulded elastically to fit its principal part. Were the hymns at morning service interrupted now and then by a gale of laughter at one of Janet's pranks? Well, then, surely God would be just as pleased as he may have been with the singing, for surely song and laughter go hand in hand in praise of the Creator's handiwork. Did Janet sometimes struggle to her moccasined feet, totter across to the reader of a morning Bible verse or poem, take the book in her hands and insist on turning the leaves? Well, then, was it not Jesus himself who had set down the little child in the midst of the people and declared that "Of such is the kingdom of heaven?" The regular order of things, program, curriculum—what had they to do with the case? They were to serve, not to dictate, to help when they might, not to inhibit wherever they could.

Before the girls went home, the baby's first words came. They were watched for earnestly and the tantalizing sounds that form the first faint dawn of speech were duly recorded. The first real laugh rippled out in the midst of a serious councilors' meeting, liquid, clear, prolonged, unmistakable. After that it was often practiced, but the thrill of hearing it for the first time was memorably sweet.

But the day of departure came, and each girl would have taken Janet home if she could. One of the older girls, whose parents were visiting camp, begged that she might have Janet as part of her Domestic Science course at Bryn Mawr. For Janet had only been adopted by the Camp Mother for the summer and was about to be returned to the steaming city where her mother tried to make ends meet on $5 a week. But the idea was too novel, too unprecedented.

Another girl was more fortunate and persuaded her home folk to let her adopt another infant temporarily, that she might continue her fascinating fun of mothering at home.

Two girls of the group, eager for the adventure of college in the fall, approached the authorities of Bryn Mawr on the subject of having a college baby. Janet had proved "practicable" at camp so why not mothercraft through the winter, too? What the college powers replied is too trite to need repeating. Needless to say, the girls went through the regular mill with only a bright memory to keep the innermost self alive.

IT WAS AN HONOR TO WASH JANET'S CLOTHES

Some of the work connected with practical Mothercraft is not, under ordinary circumstances, the pleasantest in the world; but the camp girls entered into it in the spirit of fun and friendly rivalry, and found it all interesting. Photograph by Mrs. Luther H. Gulick. (Fig. 4.)

And this is my principal point: That these girls were getting real education, the education of the affections, the training of the emotions, the directing of desire. Intellectual culture was an insignificant side play, and, although the momentousness of that tender, delicately plastic learning instrument, that small, restless mass of exquisitely sensible impressionableness grew upon them, and although the significance of the early learning process together with its evident detail was clear before them as a bit of practical psychology—that was not the capital issue at all. The mystery and wonder of childhood played incarnate before them. The marvel of it had time to sink deep into their own impressionable souls. They came to love it, and to find joy in serving it, even to the washing of its sometimes very dirty clothes. There was contagion in the child's character. They absorbed the atmosphere that its presence created. They had opportunity and leisure to learn real things.

For the very word school comes from the old Greek word *schole* (σχολή) which meant *leisure*. And education means to *draw out, lead forth* (educare). These girls had leisure to observe, to experiment, to do things of their own accord,- to ask spontaneous questions, and to sit on the great grey rocks beetling over the lake and *think*.

Eight weeks of such education—for let it not be forgotten that along with mothering Janet went swimming, dancing, canoeing, tramps on the open road and through the deep forest, handcraft, letter-writing, pantomime and play, music and stories around the open fire, reading together from good books and communion one with another around a self-cooked meal—eight weeks of

such education, as Doctor Luther Gulick has so often pointed out—is worth intrinsically more in any girl's life than a year at college grinding over books and cramming for examinations.

But need we abandon college for this? Why should we? Let the little leaven leaven the whole lump. Let our women's colleges, if they insist on nunny, feminine isolation, at least afford a part time outlet to the deeper springs that lie in the nature of every normal girl. Let us have college babies—there are thousands waiting for adoption, or a temporary adoption during early infant-hood. Let us have professors who will bring their babies into the class room as well as their books. Let us have teachers who have come up to high standards of motherhood, as well as high standards of classic learning, to draw out the mind and spirit stuff of young American womanhood. Let the women's college campus be sprinkled with baby carriages, and those of the co-ed college, too. And not for "child study," or the psychology of babies. Not for the learning process, not that coming mothers may know how to modify milk or pin a diaper; but that the finer feelings, the big and powerful affections shall be kept alive and wholesomely exercised, that the spontaneous exuberance of childhood be kept, that we remember what we are in the world for, individuals to serve the race. That is the large lesson in preparedness for the duties and privileges and joy of tomorrow. This is the spirit of the real eugenics, or foresight and devotion for the children that are to be. This is the Gospel of baby Janet, lived out in the evergreen woods.

A Champion of Darwinism

SOCIAL PROGRESS AND THE DARWINIAN THEORY, a study of Force as a Factor in Human Relations. George Nasmyth, Ph.D. With an Introduction by Norman Angell. Pp. 417, $1.50 net. New York, G. P. Putnam's Sons, 1916.

That Dr. Nasmyth should have thought it worth while to write this book is striking evidence of the prestige which Darwin, after half a century, retains. The work is in effect a piece of propaganda for world federation, which the author declares is the logical outgrowth of the Darwinian and true view of social evolution. Because those who preach the "philosophy of force" attempt to justify themselves by citing Darwin and alleging the necessity and desirability of a struggle for survival among nations, Dr. Nasmyth (following the Russian Novikov) has undertaken to show that they wholly misunderstand the Darwinian doctrines. It is not difficult for him to demonstrate this, and his chapter on "The Biological Errors" of the philosophy of force deserves wide circulation, for many biologists are prone to forget that the primary struggle for existence is against the environment of the species, and not against other members of the same species. Unfortunately, Dr. Nasmyth gives the impression that he thinks Darwin said the last word on the evolution of man, and that nothing is necessary now but rightly to apprehend his views and act on them. The sciences of eugenics and social psychology, however, have made great strides since Darwin wrote "The Descent of Man," and much of what Nasmyth seems to consider fundamental truth is now discarded dogma. Probably primitive Darwinism is less harmful to society than the perversions which Nasmyth is attacking, and which wholly ignore the factor of mutual aid in evolution. Nevertheless the interests of science—which are identical with the interests of social progress—would be better guarded if the world-federation propagandists could take their stand on the biology of today, rather than on that which Darwin knew. Beyond this, the book is marked, like most sociological works, by lack of rigid definitions and by unlimited citations of other peoples' opinions, instead of direct appeals to facts; but read with critical care, there is much in it that should prove stimulating and valuable to thoughtful people.

THE LONG-LIVED FIRST-BORN

Study of 802 Cases of Longevity Shows that Eldest Sons and Daughters are Unexpectedly Numerous—Possible Biological Explanations—Elder Children Regularly Live Longer than Younger Children

THE EDITOR

IN THE controversy over the alleged inferiority of the first-born, no direct investigation has been made, so far as I am aware, of the number of long-lived people in the community who are eldest sons or daughters. The Genealogical Record Office of Washington, D. C., has been collecting instances of longevity for several years and its founder and director, Dr. Alexander Graham Bell, has generously permitted me to investigate the data in regard to the birth-rank of the old people represented in his collection.

The individuals were, in general, over 90 years of age, some living and some dead. A few were included whose age was less than 90 but more than 80; these, however, represent a very small proportion of the total. Information about them was supplied in nearly every case by a near relative; in the case of living individuals it was often from the long-lived person himself. There were 802 cases in which the individual's birth-rank was stated[1] in some such form as, for example, "third of a family of eight;" and there seems no reason to doubt that the information given under this head is accurate.

A tabulation of the size of families from which these long-lived individuals came showed the following results:

1 child	16
2 children	21
3 children	60
4 children	75
5 children	88
6 children	92
7 children	81
8 children	98
9 children	90
10 children	79
11 children	44
12 children	30
13 or more	28

It is at once evident that long-lived people tend to come from large families—a fact that has already been pointed out in this JOURNAL.[2] It must be remembered, however, that the families here tabulated date back to the early part of the last century, when large families were the rule in the United States. All of the individuals represented in this study are living or died in the United States; many of them, however, were born abroad and came here as immigrants.

With the size of each family and the individual's place in that family given, it was easy to count up the number of individuals in each birth-rank, and then to calculate how many there would have been, if the distribution had been governed solely by chance, with as many long-lived people in one birth-rank as another. The results, taking only the families of two or more children, and omitting decimals in the second column are:

	Found	*Expected*
1st	201	132
2d	118	132
3d	104	121
4th	95	101
5th	82	82
6th	40	65
7th	53	50
8th	30	38
9th	22	26
10th	20	16
11th	4	9
12th	8	5
13th	4	3
14th	2	1
15th	3	

[1] This information was extracted by Miss Louise E. Lacey, secretary of the G. R. O., and I did not refer to the original returns. Thanks are due to A. W. Clime for help in tabulating.

[2] "Long Life Means Many Children," in the JOURNAL OF HEREDITY, Vol. VII, pp. 98–100, March, 1916.

The first thing to strike the attention is that the first-born, who have sometimes been supposed to be handicapped with all sorts of physical weakness from birth, are relatively more numerous than any other birth-rank. But the number of individuals in the last birth-ranks is somewhat surprising, in view of the generally accepted belief that the last child of a very large family tends, because of uterine exhaustion in the mother, to be defective, and is often an imbecile of the so-called Mongolian type. The table here given shows at least that the last-born of a large family is not necessarily lacking in a tough constitution which will enable him to survive for ninety years or more.

As the number of children in the ranks beyond ten is too small to give reliable comparison, I have added these together to make one rank of eleven and more children. To facilitate comparison, I have reduced the figures to a percentage basis, taking as the base-line in each birth-rank 100.[3] We then get the following fair comparison of the proportion of long-lived people which the various birth-ranks have furnished:

1st	152
2d	90
3d	86
4th	94
5th	100
6th	61
7th	106
8th	79
9th	85
10th	125
11th and up	117

The preponderance of first-born is still striking, but the high proportions in the last birth-ranks are somewhat unexpected. I think the latter situation can be partly explained on statistical, rather than biological grounds. If a centenarian were the youngest of thirteen brothers and sisters, for instance, his descendants might well be struck by the fact and remember it; therefore they would put it down in furnishing data to the Genealogical Record Office. If, however, their ancestor were in the middle of such a family, there is slightly less likelihood that they would remember his exact birth-rank and therefore they would, in a greater number of cases, leave that blank unfilled when furnishing information. This is merely a conjecture, but seems to me sufficient to account for the presence of some of these late arrivals—whose absolute numbers, it must always be remembered, are very few.

Will a similar supposition account for the presence of any of the first-born in the table? I think it very possible that relatives might more easily remember that Uncle Abner was the eldest son, than that he was fifth-born, in a family of nine. It may be, therefore, that we have in our statistics a greater number of first-born than an absolutely random sample of the population would furnish. But this appears to be a source of comparatively small, if any, error, because the preponderance of the first-born is as striking in families of two and three as it is in some of the larger fraternities. Admitting that this may have contributed slightly to swell the number of first-born, I do not think it can reduce seriously the great preponderance—217 out of a total of 802, if we include the sixteen who were an "only child." This preponderance can be well shown in another way, by the percentage table on page 397, which Dr. Alexander Graham Bell prepared.

The evidence appears to me conclusive that, among the long-lived people in the United States, eldest sons and eldest daughters are considerably more frequent than would be the case, if longevity had no connection with birth-rank.

How can we square these results with those reported[4] by Karl Pearson: that still-births are most frequent among

[3] The number found was multiplied by 100 and the product divided by the number expected. This device was used by Corrado Gini (Journal of Heredity, Vol. VI, pp. 35–39, Jan., 1915) in showing that first-born were most frequent among the college professors of Italy.

[4] Pearson, Karl. On the Handicapping of the First Born. London, 1914. Summarized in the Journal of Heredity, Vol. VI, pp. 332–336, July, 1915. Pearson's conclusions are not wholly confirmed by other data. A. Ploetz, for example, found in 3,319 births in the German nobility, that there was very little difference in the percentage of deaths under 5 years, when taken

Order of birth	Total No. of children	No. lived to be aged	Per cent lived to be aged
First born children	802	217	27.05
Second born children	786	118	15.01
Third born children	765	104	13.59
Fourth born children	705	95	13.47
Fifth born children	630	82	13.01
Sixth born children	542	40	7.38
Seventh born children	450	53	11.77
Eighth born children	369	30	8.13
Ninth born children	271	22	8.11
Tenth born children	181	20	11.04
Eleventh, twelfth, thirteenth, fourteenth and fifteenth born children	188	21	11.17
Total	5,689	802	14.09

the first-born, that infant mortality is higher among the first-born, that the health of the first-born child, during its early years, is below par?

INFLUENCE OF NATURAL SELECTION

Natural selection appears to offer a satisfactory explanation. At the birth of the first child, the maternal mechanism is less well adapted to its work than is the case at subsequent births. Particularly in the case of middle-aged women, physicians say that the strain to which the child is subjected at birth is greater at the first than at subsequent parturitions. The first-born child is, therefore, *more stringently selected* than are his brothers and sisters; a greater percentage of the first children die at birth. Now if we make the assumption that those who die are, on the average, inherently weaker than those who survive the ordeal, it follows that the average of strength, among the first-born adults in a population, would be higher than among the second or later born; not because they were as a rank superior physically from the start, but simply because a greater proportion of the weaklings were eliminated at the start.

If, then, we draw a sample of long-lived people from the population, we would expect to find more first-born among them because the initial incidence of natural selection left the surviving first-born more fit, on the average, than the surviving second, third, or fourth-born.

This hypothesis may well be supplemented by the fact which biometricians[5] have found, that the elder children are *more variable* in respect to longevity, than are the later-born. Increased variability naturally gives all the more scope for the action of natural selection; and while those who vary in the direction of physical inferiority will be eliminated at birth, the survivors will represent children who vary in physical superiority to a greater extent than do their younger brothers and sisters. This variation will naturally result in the production of a considerable number of long-lived individuals.

If the facts have been correctly interpreted, then the prevalence of first-born in a collection of long-lived individuals has a real biological foundation, and is not a mere statistical fallacy. This conclusion is supported by the fact,

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by birth-rank. See JOURNAL OF HEREDITY, Vol. V, p. 268. Researches cited by H. H. Hibbs, Jr., (Infant Mortality, p. 56, N. Y., 1916) show that in many cases the infant mortality is lowest when the mother is under 20 and when the birth in question may fairly be supposed to be her first, in a large proportion of cases. These data may not be so weighty as the larger series quoted by Pearson, but should at least be taken into account.

[5] Beeton, Mary and Pearson, Karl. Inheritance of the Duration of Life. Biometrika, Vol. I, pp. 50–99, London, 1901.

found long ago by biometricians,[6] that elder children tend to live longer than younger ones. The investigation in question did not deal directly with the first-born, but is obviously parallel to a certain extent.

Dealing with a thousand or more pairs, Miss Beeton and Pearson then found the following average ages at death:

	All adult	*Elder adult*	*Younger adult*
Sister..........	57.795	59.924	55.667
Brother........	56.568	58.560	54.575

Here an elder brother or sister was one who might have been born one year or twenty before the younger brother or sister. For both sexes, it seems that the elder lived about four years longer than the younger.

The result appeared so interesting to them that they secured 1,051 pairs of brothers and 733 pairs of sisters where the interval between births was known, and further studied them. "The data," says Prof. Pearson, "are not quite the same as for our pairs of adult brothers and sisters given above, but they show much the same advantage, *i.e.*, four years to the elder. They further demonstrate that longevity is correlated with position in the family.[7] This fact is suggestive for the source of other variations in the characters of an array of brethren. It may be that variability within the array is not purely random, but correlated like variability in longevity, with birth order. Our numbers show that on the whole the earlier-born members of a family are the stronger, or at any rate fitted to survive the longer."

It was possible from the data to work out interesting formulae for predicting the probable excess of life (e) of an elder brother or sister from a knowledge of the birth interval (i), both being taken in years:

$$\text{Elder brother } e = .7282\,i - .2795$$
$$\text{Elder sister } e = .8525\,i - 2.5951$$

"Thus a brother born ten years before another brother has probably seven years greater duration of life; a sister born ten years before another sister has probably about six years greater duration of life." It is hardly necessary to add that these formulae will rarely hold good in individual cases, but apply only when a large population is dealt with.

While these Beeton-Pearson data may appear to conflict in some ways with the Genealogical Record Office data which I have compiled, it must be pointed out that they are not directly comparable. The former were taken from pedigrees kept by the Society of Friends in England, while the latter are isolated cases picked out of a very heterogeneous population, on the basis of a single fact—that an individual had reached advanced age.

In conclusion, it has been shown that among the long-lived people in the United States, first-born are proportionately more numerous than any other children. It is suggested that this may be because they are (a) more variable in respect to longevity and (b) subjected to a more stringent selection at birth. Previous work showing that earlier-born children in a family live longer than later-born appears, as far as it goes, to corroborate the validity of the conclusion reached from a study of the Genealogical Record Office data.

[6] Beeton and Pearson, *ubi supra*.

[7] The facts as given by Beeton and Pearson, p. 54, are:

	Brothers	Sisters
Mean excess in life of elder......	4.289 yrs.	4.542 yrs.
σ of exce	22.0053 yrs.	22.1325 yrs.
Mean interval between births	6.462 yrs.	6.7503 yrs.
σ of interval	4.3530 yrs.	4.6856 yrs.
r	.1062 ± .0206	.1201 ± .0246

USUAL GROWTH HABIT OF WHITE-BARKED PINE

A typical specimen in appearance, but larger than usual. The tree stands on what was doubtless once a grave or the site of a small temple; remains of the grave or buildings have long since been obliterated by farmers. This beautiful pine has been introduced to the United States, but appears to lose its white color if it is grown in a moist locality. Photograph by D. F. Higgins. (Fig. 5.)

THE WHITE-BARKED PINE

D. F. Higgins, *Peking, China*

IN ONE of my first trips sight-seeing around the city of Peking, when almost anything new and strange was taken quite as a matter of course, I remember seeing in the enclosure of "Coal Hill" some pine trees whose snow-white bark shone out from their green foliage. I wondered at the time why it was that the Chinese whitewashed their pine trees. Later, however, in excursions into the country, I found that my whitewashed pines were not whitewashed, but that they had a white bark.

I became interested in this curious tree, and later, largely through the inspiring acquaintance formed with Frank N. Meyer, Agricultural Explorer of the United States Department of Agriculture, I took a number of photographs which may be of interest to the readers of the Journal of Heredity.

The tree (*Pinus Bungeana*) is most striking and noble in appearance, and

THE PINE IS OFTEN PLANTED NEAR A TEMPLE

This specimen stand in the ground of Tan Chao Ssu, a famous temple in the mountains west of Peking. With the brilliant white bark and clear green foliage among the yellow and green tile roofs, all against the dark green of juniper and oak-clad hills, it is a sight not soon to be forgotten. This is the finest specimen seen among several hundreds in the vicinity of Peking. Photograph by D. F. Higgins. (Fig. 6.)

would form an attractive addition to any park or estate. There is a feeling of awe and mystery inspired by the flashes of brilliant white through a shadowed grove such as might arise if elves were lighting fox-fire by day. The fact that the trees are planted principally about grave sites does not tend to lessen this feeling.

Besides being used for ornamental purposes around graves, they are also to be found in many of the temple grounds which abound on the plain around Peking and nestle in the mountains west of the city. I have seen no trees not planted by man, but I have heard that this tree grows wild in the low mountains west of Paotingfu, some distance southwest of Peking. The species seems to be one nearly extinct, and which thrives only in narrow climatic limits. Its introduction into the United States would be worth while attempting, however.[1] Mr. Meyer has superintended the securing of one of these trees which has been placed over the grave of W. W. Rockhill, late United States minister to China.

The Chinese name of the white-barked pine is "pai kuo sung," pronounced locally about Peking, "pai-kuor-sung," "the white fruit-pine." This name is due to its white bark, and to the use of the seeds as a delicacy and in confections.

On the Proportion of "Born Criminals"

Discussing "Defect in germ-plasm as a cause of delinquency" in an editorial in the July issue of the *Journal of Delinquency*, Thomas H. Haines, director of the Ohio Bureau of Juvenile Research, concludes that 25% is about the limit of feeblemindedness that can be found in any unselected delinquent population—for example, the inmates of a penitentiary or reform school. Feebleminded is here used to mean that "they are so poorly endowed with intelligence that they are unable to manage themselves and their affairs with prudence." Better tests are needed, Dr. Haines says, to get at the mentality of the rest of the delinquents. "That there is mental abnormality of some sort underlying the moral perversion, in a large percentage of not insane and not feebleminded delinquents, we are free to grant. . . . But there is much abnormal mentality that is not due to defect in germ-plasm." This, Dr. Haines thinks, is the result of bad education, and can be corrected in many cases by proper treatment. For the hereditarily defective mind, little can be done.

The Inheritance of Feeblemindedness

In the May and July issues of the *Journal of Delinquency*, Arthur S. Otis, of Stanford University compares the conflicting views on the manner in which feeblemindedness is inherited. There can be no doubt but that heredity is to a large extent accountable for different degrees in brightness; the question is whether or not these different degrees of brightness can be said to be inherited as Mendelian unit characters. After reviewing the conflicting views, Otis concludes that no good case has yet been made out by the Mendelists, and that while Mendelian heredity of degrees of intelligence is easily conceivable, it cannot be proved until we have more knowledge of the development of the mind, and better means of measuring our quantities.

[1] The office of Foreign Seed and Plant Introduction, United States Department of Agriculture, has sent out seedlings of this pine (Inventory No. 41954) secured by Mr. Meyer, and these are now growing at various places in the United States. A large specimen introduced earlier by Dr. C. S. Sargent is growing in the Arnold Arboretum, Boston. It does not show the white-barked character, and it is quite possible that this will only appear on specimens grown in a dry climate. The Office of Foreign Seed and Plant Introduction will be glad to correspond with anyone who wishes to grow this pine in the United States.—The Editor.

POLLINATION IN THE PINE

PLANTS which depend on the wind for fertilization must necessarily have pollen adapted to travel by air. If a plant regularly depends on bees or other insects to carry its pollen, the pollen-grains are likely to be sticky and fairly large. If, however, the pollen must be transported by the wind, then the grains must necessarily be as light as possible and sometimes, as in the pine, they are furnished with wings or air sacs to buoy them up.

So equipped, pollen grains can travel almost incredible distances. Engelmann, a careful and trustworthy observer, reports:[1]

"The property of the pine pollen to float for a long time in the air, and to be carried by storms to very distant localities, is well known. I have found in streets of St. Louis after a rainstorm from the south, in March when no pines north of Louisiana were in bloom, pine pollen which must have come from the forests of *Pinus australis* on Red River, a distance of about 6½° of latitude or 400 miles in a direct line."

The male and female flowers of the pine are quite distinct, as will be seen from Fig. 8, but are borne on the same tree. The male cones appear in the eastern United States late in the fall, lie dormant through the winter and ripen their pollen in the spring, the pollen being ready for dispersal in May or June. In March or April the female cones can be distinguished; they develop rapidly until they are mature at the same time as the male cones.

At about the time that the staminate flowers are launching their clouds of glistening pollen on the wind, the axis of the female cone elongates, thus forcing open the scales, which heretofore have been pressed together and have presented an impenetrable exterior. At the base of each scale are two ovules, not enclosed in

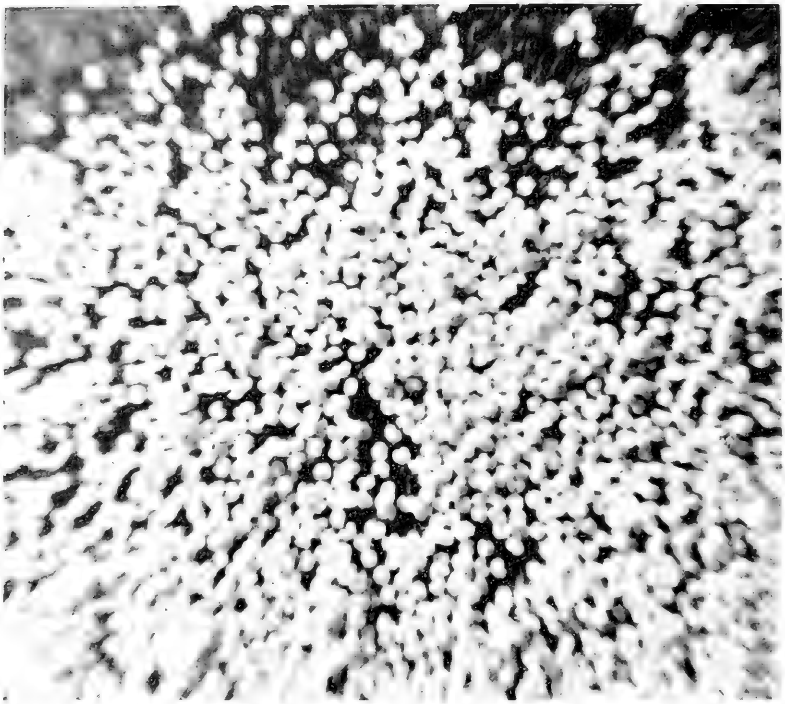
FECUNDATION OF THE OVULE

The ovule or egg-cell of the pine (*P. austriacus*) is here photographed, immensely enlarged, about one year after it was pollinated. The pollen grain has lain dormant within it for that length of time, but is now beginning the actual fertilization. In the center of the egg can be seen the large maternal nucleus at the top of which the functional male nucleus has made a deep depression—a feature characteristic of the pines. Very shortly it will enter the egg-nucleus at this point and the two nuclei will unite, bringing together the hereditary material which each carries and thus starting the development of a new tree. At the upper end of the ovule a large vacuole is seen as a clear spot, to the left of which is the second male nucleus, which takes no part in fecundation. Photo-micrograph from David M. Mottier, Bloomington, Ind. (Fig. 7.)

[1] In Trans. St. Louis Academy, Vol. IV, p. 159.

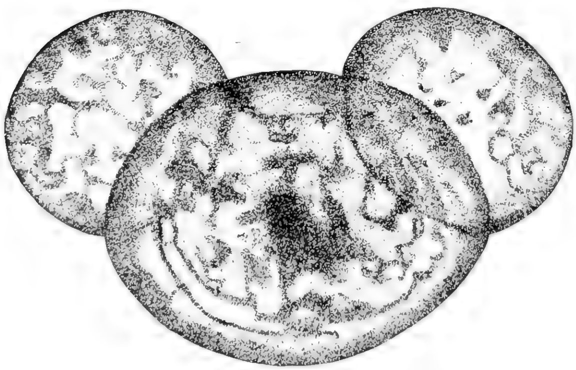
FLOWERS OF THE PINE

At the base of the spike is a cluster of male cones, which have already opened and begun to shed their pollen. Grains of the pollen can be seen sticking to most of the pine-needles in the photograph. Above is a single female cone branching from the slender twig. The pollen of the pine is carried by the wind, insects playing no part in the pollination of this tree. Photograph, much enlarged, by David Fairchild. (Fig. 8)



GRAINS OF PINE POLLEN

They show little tendency to stick together, whereas the pollen of plants that depend on insect visitors is often exceedingly sticky, so that it will adhere to the legs and bodies of insects. The pollen of the pine is much smaller than that of most plants; it is here shown as seen by reflected light. Photo-micrograph by David Fairchild. (Fig. 9.)



THREE-CELLED POLLEN GRAIN

The pollen of pines is adapted to travel with the wind by the possession of wing-cells or balloons. The grain consists of three cells, one of which is fully developed and contains the nucleus, while two at the sides are hollow and contain nothing but air. They buoy up the nuclear cell and enable it to travel almost incredible distances—as far as 400 miles in extreme cases. Drawn by W. H. Lamb, of the U. S. Forest Service. (Fig. 10.)

an ovary as is the case with most flowering plants, but lying quite exposed, as with all the gymnosperms or "naked-seed" plants. Pollen drifts into the openings between the scales and slips down to the base, where some of the grains fall on the ovules. There is an opening to each ovule, and the opening is surrounded by a collar of cells which form a tube to receive the pollen. When the pollen grain is once inside this tube leading to the ovule, the opening closes up so that it cannot get out. Shortly afterwards, the scales of the cone are said to close up once more, thus protecting the ovule during the course of its further development.[2]

With many flowers, fertilization—that is, the union of the sperm-cell and egg-cell—takes place almost immediately after pollen has reached the ovule. But in the pine there is an extraordinary delay, often covering a period of thirteen months. The pollen-grain does indeed begin to germinate immediately after it has entered the ovule. But when it has gone through a few divisions, and put forth a pollen tube, it rests for a year. Not until late in the following spring, in most species, does it actually reach the egg-cell.

When fertilization does take place, it is more thorough than in many species. Not only do the nuclei of the two cells unite, but the cytoplasm of the two cells fuses, whereas in many cases the cytoplasm—that is, all the material surrounding the nucleus—of the male cell is rejected.

To obtain a good photograph of the process of fertilization is a very rare thing, but Prof. David Mottier, of Indiana University has sent the remarkable one reproduced in Fig. 7. Here the two nuclei can be seen, just about to unite. Most, if not all, of the heredity of the species seems to be carried in the nucleus of the cell; consequently it is the union of cell-nuclei that constitutes the essential fact in zygosis or fertilization. By this act the inherited characters of the male and female parent are brought together, to lie side by side in the individual which results from the growth of the fertilized cell, and to be shuffled up, recombined and segregated in its posterity.

Breeding Sugar Cane

Four generations of seedling cane are being grown at the Porto Rico experiment station, Rio Piedras, P. R., and several new varieties of value have already been developed. It has been found almost impossible successfully to pollinate cane by hand, because of the smallness of the cane flower, the height at which the inflorescence is produced, and its brittleness. Success has been had, however, by planting two varieties in parallel rows, a pollen-sterile variety on the leeward side of one pollen-fertile. The wind does the rest.

State Survey in Illinois

The Illinois Committee for Mental Hygiene is contemplating a state-wide survey of the amount and ramifications of mental defect. The work would be centralized in Chicago. This action is in line with that taken recently by a number of communities, and must eventually be followed by the whole nation, as the realization becomes more widespread that a large part of the crime and misery is due to inherited mental defect, and that most of it can be wiped out, within a generation, without excessive labor or expense.

[2] For a careful technical account see Ferguson, Margaret C. Contributions to the Knowledge of the Life History of Pinus, etc. Washington, 1904.

A CHANGE IN SEX-RATIO

Overwhelming Preponderance of Male Births Among Certain Tribes of Costa Rican Indians—Females in Great Majority Among Adults—Tribes Rapidly Disappearing

Henry Pittier
Bureau of Plant Industry, Washington, D. C.

In 1903, I published in the *Berlin Zeitschrift für Ethnologie* a short note on the Tirub, or on what is left of that once powerful tribe, dominating the plains and mountains bordering on the present boundary line of Costa Rica and Panama. The abode of these remnants is now restricted to the upper reaches of the Tararia or Changuinola River, included in the territory of the latter republic.

In the above mentioned contribution, there were given some statistical data showing the rapid decrease of the Tirub and the unusual numerical disproportion of the sexes, the great majority of children being males.[1]

I visited these natives in 1898 and the statistical information reproduced about five years later from my diary was given as a résumé of the complete census made during my expedition, the originals of which had been mislaid.

Not very long ago, these detailed sheets of my census were found. They cover not only the whole Tirub tribe, but also the larger part of the Bribrí of the Costa Rican Talamanca. In view of the numerous researches and publications referring to sex determination and control, these data appear so interesting that I now undertake to prepare them for publication. I do this also in justice to the readers of my former article and because such information may throw some light on the process of disintegration of a race.

The above cited paper dealt with a portion only of the Tirub, and showed a proportion of thirty-six females to 100 boys among the children. It further stated that since the first known census, in 1700, when the tribe numbered about 2,300, there has been among them a steady and rapid decrease in the natality until in 1898, there were left fifty-seven individuals, among whom were fourteen boys and five girls under marriageable age. The real figures at that time as shown below should have been given as eighty-nine individuals with thirty-one boys and eleven girls, and a slight predominance of the males among the adults. Among the children, however, the given sex ratio remains the same with the new totals.

It was shown further that the same process of rapid extinction, indicated not only by a lesser natality but also by a great exaggeration of the sex ratio, existed in another Costa Rican tribe, the Guatusos, living at the headwaters of the Rio Frío. In 1896, Bishop Thiel found it to consist of only 203 individuals, seventy of whom were females, the ratio being fifty-two of these to each 100 males.

In the same expedition during which the Tirub information was gathered, I made also, as stated above, an extensive survey of the inhabitants of the valleys and mountains of Uren in the Costa Rican Talamanca. These people belong to the Bribrí tribe, another part of which inhabits the district of Ararí, which I did not visit at the time. There

[1] Similar disproportionate sex-ratios are said to have been found among the Indians of Guatemala and Nicaragua, and parts of South America, but in no case has the state of affairs been described by such an accurate census as Mr. Pittier was able to make. E. Westermarck cites the travelers' accounts in his "History of Human Marriage," Chapter XXI. Among other primitive peoples, it would appear that the proportion of girls born is sometimes equally excessive. In civilized countries there appears an extraordinarily steady ratio of something like 105 boys to 100 girls born.—The Editor.

is also a small settlement of the same Indians in the Cabagra Valley, on the southern watershed of the cordillera.

The results of both the Tirub and Bribrí censuses are now given in full, as follows:

I. Census of the Tirub Tribe.

Name of locality.	Adults.		Children.		Totals.		Grand totals.
	Males.	Females.	Males.	Females.	Males.	Females.	
Brusik 1st house	1	1	3	0	4	1	5
Brusik 2d house	1	1	2	0	3	1	4
Brusik 3d house	1	3	2	0	3	3	6
Urustán	2	4	5	0	7	4	11
Iabólu	1	3	3	0	4	3	7
Surtsik	5	5	5	0	10	5	15
Ararbó	3	5	3	3	6	8	14
Peksó	1	2	3	2	4	4	8
Uniâ	1	4	2	3	3	7	10
Temisik (Śongsó)	2	1	3	3	5	4	9
Houses 10	18	29	31	11	49	40	89

II. Census of Part of the Bribrí Tribe.
(a) Bribrí Mountains, Talamanca.

Name of locality.	Adults.		Children.		Totals.		Grand totals.
	Males.	Females.	Males.	Females.	Males.	Females.	
Stutuk	5	5	6	3	11	8	19
Sinitz	2	2	2	0	4	2	6
Ukábęta	2	2	0	2	2	4	6
Dutsábęta	3	3	3	2	6	5	11
Akutz	4	3	4	3	8	6	14
Bęríbęta	3	7	1	1	4	8	12
Dępuk	3	4	2	2	5	6	11
Durúnu	2	2	2	1	4	3	7
Bóbri	2	5	2	3	4	8	12
Tsukuñak	3	6	3	1	6	7	13
Skarúbkitsa	2	4	0	9	2	13	15
Dutz	2	3	1	2	3	5	8
Suríski	4	3	0	0	4	3	7
Bętsúokir	4	4	0	1	4	5	9
Butz	3	2	3	0	6	2	8
Dutsábęte (2)	5	3	2	1	8	4	12
Dutsásura	2	7	2	2	4	9	13
Urítska	1	3	2	1	3	4	7
Tuki	4	6	3	1	7	7	14
Bísbęta	3	4	2	1	5	5	10
Tsuríkur	3	4	3	2	6	6	12
Korímbęta	2	3	0	0	2	3	5
Torókkitsa	2	3	0	1	2	4	6
Puríbęta	2	4	2	3	4	7	11
Torókdipe	2	4	2	3	4	7	11
Nęmu-ú	2	3	0	3	2	6	8
Mokri	7	5	2	1	9	6	15

Name of locality.	Adults. Males.	Adults. Females.	Children. Males.	Children. Females.	Totals. Males.	Totals. Females.	Grand totals.
Burúbęta	3	3	1	0	4	3	7
Amókitsa 1st house	2	6	1	0	3	6	9
Amókitsa 2d house	3	1	2	0	5	1	6
Tsambri	3	3	1	0	4	3	7
Tsukátz	2	3	3	0	5	3	8
Surébeta	3	5	0	3	3	8	11
Dękó-ú	4	5	1	0	5	5	10
Surúk	5	5	1	1	6	6	15
Xkurdzuk	2	3	0	0	2	3	2
Kúko	1	3	0	1	1	4	5
Sęuís	3	3	2	0	5	3	8
Buráburábęta	2	4	5	0	7	4	11
Trútuk	2	2	0	1	2	3	5
Urúkbęta	4	6	1	3	5	9	14
Kátsibęta	3	2	2	3	5	5	10
Nęuós	4	2	2	1	6	3	9
Surítuk	2	3	1	1	3	4	7
Karkádzęua	1	1	2	1	3	2	5
Bikatz	2	2	0	3	2	5	7
	130	166	74	58	204	224	428
(b) Inner plain of Talamanca.							
Tsáki	1	1	3	1	4	2	6
Tsimukurki	1	1	4	1	5	2	7
Konó-uoripe	5	6	2	3	7	9	16
Sauskurki	1	1	0	0	1	1	2
Sausbęta	0	1	2	0	2	1	3
Bękitsa	1	2	2	3	3	5	8
Datsí-kurki	1	1	1	0	2	1	3
Sklúkote	3	3	3	1	6	4	10
Dicóte 1st house	1	3	5	1	6	4	10
Decóte 2d house	2	4	0	0	2	4	6
Dicóte 3d house	1	1	2	1	3	2	5
Dicóte 4th house	0	2	2	1	2	3	5
Dicóte 5th house	1	2	3	0	4	2	6
Dicóte 6th house	2	1	0	1	2	2	4
Tea	5	6	5	4	10	10	20
Bękurki	2	2	1	2	3	4	7
Kitákitsa	1	1	0	0	1	1	2
Kokbliñak	2	3	5	3	7	6	13
Skarúbkitsa	2	3	2	0	4	3	7
Dutsákurki	2	4	2	0	4	4	8
Tsanáki	3	5	3	3	6	8	14
Bękátsuo	3	3	1	0	4	3	7
Korbliñak	1	1	2	0	3	1	4
Hacienda	2	2	1	0	3	2	5
Tsuríkurbri 1st house	3	4	1	1	4	5	9
Tsuríkurbri 2d house	1	0	1	0	2	0	2
Murusíkdio	2	2	3	1	5	3	8
Ogdi	6	7	2	2	8	9	17
Tsrarkorñak	4	4	3	3	7	7	14
	59	76	61	32	120	108	228
Mountain Bribrí	130	166	74	58	204	224	428
Plain Bribrí	59	76	61	32	120	108	228
Grand totals	189	242	135	90	324	332	656

Males and females to each 1,000 *of population.*

Tribe		Males.	Females.
Tirub	Adults	202	326
	Children	348	124
	General	550	450
Bribrí	Adults	288	369
	Children	206	137
	General	494	506

Tribe or part of tribe.	Females to each 100 males.		Males to each 100 females.	
	Adults.	Children.	Adults.	Children.
Tirub	161	36	62	262
Bribrí (Mountain)	128	78	78	128
Bribrí (Plain)	129	52	78	191
Bribrí (General)	128	67	78	150

The known history of the Tirub shows that during the seventeenth century, they constituted a powerful nation, which extended its sway over all the neighboring tribes. They made frequent raids on these, plundering, killing the men, carrying away women and children. The fact that at that time and as long as they were able to maintain their supremacy, they were essentially exogamous, and also polygamous, should perhaps not be overlooked when studying the probable causes of their decadence. The existence at one time of both conditions is proved not only by repeated documentary mention of the abduction of females of all ages, but also by tradition and actual occurrence. The Térraba Indians still speak of a time when each man was allowed several wives, and also of the punishment inflicted by the friars when the monogamic rule imposed by them was infringed. On the other hand, during my residence in Térraba, one of the former Tirub colonies in the Diquís Valley, I became acquainted with several natives who had taken their wives from among the Bribrí and Cabécara of the northern slope. Asked about the reason why they had gone so far to find their matrimonial mates, one of these men tried to explain that such wives were more "recatadas," *i.e.*, modest or shy, than those of his own surroundings, but others referred to the fact that such was the practice among their forebears and that this was encouraged by the missionaries.

Notwithstanding all the evidences of the practice of exogamy before the advent of the Spaniards, I must not omit to mention that there are also vague indications of the tribe having been at one time organized in two clans between which marriages took place exclusively, as will be explained in connection with the Bribrí.

The decadence of the Tirub started with their subjection by the Spaniards at the beginning of the eighteenth century. The persuasion of the missionaries and the fear of a bloody repression put an end to the inroads on their neighbors and to the practice of exogamy. A considerable part of the tribe was led away to the several colonies founded by the friars in other parts of the country and no small number were driven to the Spanish settlements to become the slaves of their conquerors. Worse still, smallpox, pulmonary and catarrhal infections, almost always fatal among them, and other imported diseases took a heavy toll among the once strong and warlike nation.

Heretofore, they had roamed freely over mountains and vales, spending the dry season fishing and hunting in the extensive plains along the coast and retiring with the accumulated provisions for the rainy winters in the sheltered fastnesses of their hinterland. In the plains were also their extensive plantations, built up for each family by the common work of the community with the accompaniment of eating and drinking revelries, as is still the custom

among the Talamanca Indians. Their crops consisted mainly of cassava and plantains, to which squashes and red peppers were probably added. Maize was hardly cultivated and beans were certainly unknown, since up to the present day they are found but seldom among the aborigines of the Atlantic coast of Costa Rica.

DRIVEN FROM THEIR HOMES

While this simple diet remained plentiful, the nation continued to thrive, until strangers began to invade the more accessible parts of their territory. Year after year these came in growing numbers, settling themselves in the fields of the hapless natives, who were thus robbed of their subsistence and frightened back into the narrow valley of the Tararia. The climax of the spoliation came about the time of my visit, when speculators grabbed what was left of the rich lands of the plains in prevision of future operations by a large banana concern.

These changes took place gradually, and gradually too, the living conditions of the natives became more impaired The narrow talweg of the valley, swept year after year by the torrential freshets of the larger streams, could not be tilled profitably, and the slopes are everywhere too steep for permanent cultivation. So the crops were forcibly reduced to a scanty minimum. The fish which abound in the lower course of the river, become scarce in the upper reaches and, at the time of my visit, the forest game had practically disappeared. All this necessarily resulted in a slow starvation of the Tirub, with the corresponding lowering of the vitality of the race. The resistance to diseases and other adverse conditions became less, the rate of mortality increased and with a diminished number of births came also the disturbance of the ratio of sexes as vividly shown in the above tables.

Among the Bribrí, the process of attrition has been about the same, though perhaps a little slower. These were among the people subjected to the dire oppression of the Tirub during the period preceding the arrival of the Spaniards. At that time also they were more or less obliged to seek the seclusion of their mountains, their enemies extending over most of the beautiful inner plain of Talamanca. Besides they paid tribute, according to tradition, to the Misquito Indians, who at that time dominated the coast from Gracias à Dios in the North to beyond the Chiriquí Lagoon, as is indicated still by numerous local names. A tradition gathered from the old men in Bribrí has it that each year, the flotilla of the warring Misquitos would appear at a certain time at Cahuita Point, and a slave runner was dispatched to the Bribrí bearing the insignia of command, a cane made of the cacique wood. This put the whole tribe on the way to the coast, every man and woman loaded with propitiatory presents. After the Spanish occupation, this dependency came to an end, though very much against the will of the Misquitos, who tried by every means to maintain it, and even penetrated once far into the Talamanca Valley with their dugouts after they had succeeded in crossing the dangerous bar at the mouth of the Tarire. On this occasion, however, they were not satisfied with provisions and cotton clothes, the usual tribute levied on the Bribrí, but a number of women and children were carried away into captivity.

After the last appearance of the Misquitos and the retreat of the Tirub into their own valley of the Tararia, the Bribrí enjoyed a relative quiet and attained some prosperity under the easy rule of the friars. Not that they submitted altogether meekly, for there were times of open revolt, when missionaries and colonists were pitilessly massacred and the churches and incipient towns destroyed. These outbursts were of course followed by bloody reprisals, but on the whole the tribe maintained itself in a relatively prosperous condition even to the last days of the past century.

MARRIAGE BETWEEN CLANS

With relation to marriage, their customs were very different from those of the Tirub. While polygamy was the

rule, the wives were taken from inside the tribe, according to a system which we might call semi-exogamic. The whole tribe was divided from the oldest times into two clans, each one of which was considered by the other as its "contrary." The men of one clan could marry only in the opposite clan, to which the children would also belong, the head of the family being not the husband, but the eldest brother of the mother. This custom was still rigidly enforced at the time of my exploration of Talamanca (1891–1898), when I succeeded in obtaining the complete list of the families forming each clan of the Bribrí.

Owing to this arrangement, the inner life of the tribe was not perhaps so deeply disturbed by the advent of Spaniards as was the case among the Tirub, and this is one of the explanations of the reason why the decadence of the Bribrí has proceeded more slowly, as shown by the above tables.

One of the first facts which draws the attention when studying these is the reversal of the ratio of sexes when we pass from the adult to the child generation. Among the former the number of females is far above the normal in all cases, while among the children the male element is overwhelmingly preponderant. It would seem, therefore, that the change has been a very sudden one, and this puts more difficulties in the way of a satisfactory explanation. That the adverse circumstances under which these natives live have been rapidly on the increase during the last years is an evident fact. The question is whether it would be sufficient argument to explain both the decrease in natality and the great disturbance of the sex ratio.

It has been suggested that certain native tribes limit the number of females by killing part of the baby girls at their birth. This, however, would not explain the present case and furthermore it certainly does not apply with regard to the Bribrí Indians, among whom I lived for nearly three years and into whose more intimate life I pried almost at will. Not being an admissible explanation for the Bribrí, this could not be used as to the Tirub, whose case is more or less identical.

On the other hand it is generally admitted that there is an automatic correlation between the birth rate and sex ratio on one side and the general vital conditions of the race on the other. The only apparent exception to that law is the presence of artificial conditions as produced by abuse of wealth and excessive physical refinement, as are known to exist in great cities and which lead so surely to race suicide. Under normal conditions, a strong, healthy stock tends to increase and with a higher rate of birth there is also a surplus in the number of females. Under adverse conditions, the facts become reversed. For instance, in a nation depleted of men and resources by war, natality is less and the proportion of males considerably larger. While statistical proof of these facts is inadequate, there is some evidence to support them, and they formed the base of the explanation given in my former paper.

Whatever this explanation, it is evident that factors have been in operation among these Indians that have resulted in a definite and pronounced alteration of the sex ratio.

Research Work at Sing Sing

At the annual meeting of the National Committee on Prisons it was announced that a fund of $20,000 a year for five years has been guaranteed to provide medical and scientific treatment for the prisoners at Sing Sing. The Committee on Eugenics has begun operations in cooperation with the Police Department of New York City to arrive at the constitutional or hereditary factors in anti-social behavior with the aid of carefully compiled family histories.—*Eugenical News* (Cold Spring Harbor, Long Island, July, 1916.)

HEREDITY OF HAIR-FORM

STRAIGHT hair is the primitive form found in the human race, but in some sections, particularly those inhabiting the tropics, a modification appeared very early in history, and resulted in the various forms known as curly, kinky (or frizzy) and wooly. The difference is in the form of the individual hair: straight hairs are round in cross-section, while

AMERICAN NEGRO x FILIPINO HALFBLOODS. (Fig. 11.)

the curved ones are seen, in cross-section, to be flattened, being sometimes only half as thick as broad.

Going farther back, we find that the difference in appearance is due to a difference in the shape of the follicles from which the hairs grow: straight hair develops in a plain, cylindrical follicle, while the follicle which produces the flattened types of hair is curved and inclined in relation to the skin. Apparently this change is one, the possibility of which is often present in human germ-plasm, for it breaks out occasionally when there is no hereditary history back of it, so far as can be discovered, for a number of generations.

It was noticed very early in the Mendelian study of heredity that these types were inherited distinctly and segregated. Davenport pointed out[1] that the curved condition seemed to behave as a dominant and the straight condition as a recessive, although his figures show that this does not hold strictly true, so that it is probable we are here dealing with a number of different heritable factors, instead of a single one—unless we suppose that it is a single factor which is subject to much variation.

The accompanying photographs from David B. Mackie, of Manila, show two sisters at Pangasinan, Philippine Islands. They are the offspring of a Philippine woman who had the straight hair characteristic of the Malays, and an American negro with wooly hair. This father, however, in Mr. Mackie's opinion, had some white blood, and therefore may be considered heterozygous for hair-form. Were this not the case, we should expect to find all his children with curling hair. The fact that one of the sisters has distinctly curling hair and the other distinctly straight hair is in itself fair evidence that the father was not a pure-blood negro. The photograph graphically illustrates the fact that hair-form is not a blending, but a segregating, character in heredity.

Effects of Alcohol on Germ-Plasm

That alcohol acts on the germ-plasm in such a way as to cause defects in offspring, has long been believed, but those who have investigated the evidence know that very little of it is valid. Dr. Raymond Pearl of the University of Maine is carrying on experiments with fowls to test the effect of alcohol, and finds no evidence that it has the effects attributed to it. A preliminary account of his experiments is given in the *Proc. Am. Philos. Soc.*, LV, pp. 243–259. He treated nineteen fowls with alcohol and raised 234 chicks from them. "Out of twelve different characters for which we have exact quantitative data, the offspring of treated parents, taken as a group, are superior to the offspring of untreated parents in eight characters" and inferior in two, while in the remaining two characters there is no distinguishable difference. The infant mortality, among chicks of treated parents, was decreased, the chicks were heavier than normal when hatched, and grew faster than the average. No deformities were found. Dr. Pearl thinks the effect of the treatment was to eliminate the weaker germs in the parents, so that only the stronger germs gave rise to offspring. He is continuing the experiment with larger numbers of birds to get data for several generations.

[1] Davenport, C. B., "Heredity in Relation to Eugenics," p. 34. New York, 1910.

CONSTITUTIONAL VIGOR IN THE ANCESTRY OF THOMAS A. EDISON

THOMAS A. EDISON'S extraordinary ability to support fatigue, and to work many hours at a time with little food or sleep, is well known, and the inventor frequently attributes this ability to his abstemiousness. George W. Barton, of Washington, has recalled this in a letter to Alexander Graham Bell, in which he quotes from an interview with Edison, by Dr. Richard Cole Newton, in the *Ladies Home Journal* several years ago, as follows:

"Years ago a book fell into the hands of the great-grandfather of the present Thomas A. Edison, the famous inventor. It was the story of an Italian nobleman, Lodovico Cornaro, who at the age of forty was told by his physicians that he had but a short time to live.

"Cornaro lived in an age—three hundred and fifty years ago—when eating and drinking cut a prominent figure in the lives of Italians, and this nobleman concluded that his broken health was due to over-indulgence. He resolved to change his mode of life and demonstrate a truth or two to the physicians.

"After some experiments in his diet he cut down his daily ration of solid food to twelve ounces, the equivalent of three-quarters of an ordinary five-cent loaf of bread. Next he determined to let fresh air into his house, and to live himself in the fresh air as much as possible and avoid all contention and worry. With these fundamental laws for healthful living he built up for himself an ideal mode of life. Health came back to him, and at the age of eighty-three he made known to the world, in print, what he had done and how he had thrived by his method.

CORNARO'S LONG LIFE

"His health had now become as good as it had been before he had injured it as a young man by improper living, and at the age of eighty-six he again reported on his vigor, his happiness and his freedom from all the ills of advanced age; at ninety-one he reported again and at ninety-five he added still further to his wonderful book that anyone may read today. He died at the age of ninety-eight, having lived fifty-eight years, in good health, beyond the date fixed for his demise by his physicians—and he outlived them all!

"So impressed was the great-grandfather of the present Edison with the sane and rational story of this fine old Italian nobleman that he took the teachings to himself and lived along the line of Cornaro's methods for years. He died at the age of one hundred and two years.

"The example of Mr. Edison's great-grandfather's long and healthy life was naturally not lost upon the son, and he—the present inventor's grandfather—followed the same teachings and died at the age of one hundred and three.

"The example of the grandfather of the present inventor was in turn impressed upon his sons, of whom there were seven. They all lived according to the teachings of Cornaro, and the example set before them by their father and grandfather, and all seven sons lived to be more than ninety years old!

"One of these sons was Samuel Edison, father of the inventor. He followed in his eating and in his daily life the example of his father and lived to the age of ninety-four years, passing away without apparent illness. He suffered no pain, life seeming to have come to its end in nature's way.

"This, then, was the marvelous record of abstemious living and consequent old age handed down by great-grandfather, grandfather, and father and six uncles to the present Thomas A. Edison. He determined that 'what was good enough for his ancestors was good enough for him,' and decided to

live the same life. This he has done with the result that the great inventor finds himself today, at the age of sixty-five, in sound health; with the wonderful record that he has been sick just four times in sixty-five years; he has had three or four headaches, and two or three winters ago he had a slight cold, the first in ten years. He has also had an attack of so-called middle-ear disease, from which he recovered in two or three weeks. This was in 1908, since which time he has been very well and hard at work.

"Naturally everyone will ask, what is this marvelous routine that has made possible this wonderful record? In the first place the routine is not marvelous at all; it is simply common sense, which, if followed by more of us, would obviate nearly all our illnesses and make it possible for us to reach the ages attained by Mr. Edison's ancestors, and to enjoy as good health as does the great inventor himself."

FALLACIOUS REASONING

Unfortunately for the interviewer's conclusion (which appears to be Edison's own) there is abundant evidence to prove that long life is due largely to heredity. The fact that an ascetic dietary is in this case *associated* with long life by no means proves that it *causes* long life.

"If Thomas A. Edison should live to be a nonagenarian or centenarian as he intimates he will through this methodical mode of a restricted diet, would it be a fair scientific deduction to attribute his longevity to the hereditary factor, or to his ascetic dietary?" Mr. Barton asks. To this Dr. Bell replied as follows:

"Both heredity and environment are undoubtedly factors in producing longevity. My researches indicate that the possibility of long life depends primarily upon the possession of a good constitution (which is an inheritable characteristic); and secondarily upon good habits of living (which are not inheritable).

"The case cited by you, of Edison's ancestors, is obviously one in which heredity is involved; for you have here a man living to 102 years of age, having a son who died at 103, and seven grandsons who all lived to be over 90.

"It is inconceivable to me that a system of diet could possibly be the cause of so extraordinary a result. It is more reasonable to suppose that a tendency to longevity existed in the family, and that the good habits of life permitted it to come into expression. In this connection it is interesting to know that a hereditary tendency to longevity appears in many families in spite of the prevalence of most unhygienic conditions.

"The case of the Italian nobleman, Lodovico Cornaro, who lived to be 98 after having been given up by his physicians at 40, is interesting but by no means conclusive, because nothing is said about his ancestors. It is true that he attributed his long life to his system of diet; but in most of the cases I have investigated where the excellent habits of life were supposed to be the cause of the longevity, I have found that the individuals came of long-lived stock."

Banns Law Proposed in Georgia

The desirability of a good banns law, as an aid to sexual selection, has been pointed out in this Journal. By preventing hasty and ill-considered marriages, it would probably tend to better matings from a eugenics point of view. The following news item from the daily press is of interest in this connection:

"Atlanta, Aug. 20.—A strict measure intended to curtail immorality and the divorce evil by preventing hasty marriages probably will be passed by the present session of the legislature.

"The bill provides five days must elapse from the time a marriage license is taken out before a ceremony can be performed; that there must be at least two competent witnesses; that the issue of a license must be published, and sworn statements must be made as to age and previous marriage."

PYRONIA

A Hybrid Between the Pear and Quince—Produces Abundance of Seedless Fruit of Some Value—Many New Combinations Might be Made Among the Relatives of the Pear

Dr. L. Trabut

Botanist of the Government of Algeria, Algiers

EARLY in 1913, Mr. Veitch, of London, sent me some cions of a hybrid he had recently obtained between Pyrus and Cydonia. He called this interesting creation Pyronia, and asked me to study it under the more favorable climatic conditions of our region. Since this new plant had proved to be an attractive ornamental shrub in the climate of London, I thought that in Algeria the fruits might be comestible, and Pyronia might become one of our cultivated orchard trees. The cions received were therefore grafted on well-grown stocks of a Moroccan pear recently described[1] (*Pyrus gharbiana* Trabut), which were growing in poor soil at the Botanic Station.

In November of the same year the cions had made a growth to 2 meters, and were as large as one's thumb at the base. In 1914 the first fruits appeared on variety A.

In the spring of 1915 they flowered abundantly and set a large quantity of fruit. The observations here described will deal only with the variety A, to which I have given the name X *Cydonia Veitchii* var. *John Seden*. It may be described as follows:

A vigorous tree resembling the quince, the wood brown with numerous lenticels. Leaves light green, the vernation very peculiar; one side of the leaf blade is inrolled, as in the pear, the other side, in place of being inrolled symmetrically, encircles the first so perfectly that the vernation may be called convolute. It is therefore intermediate between the conduplicate vernation of Cydonia and the involute vernation of Pyrus. Leaf-blades elliptic, entire, villous when young though very sparsely so on the principal veins and the petiole, the venation irregular; petioles one-third to one-fourth as long as the blades. Stipules inserted at the base of the petiole, villous, on vigorous shoots attaining a length equaling that of the petioles. The leaves adjacent to the flowers which appear in the first flowering period are larger than the normal ones, and less attenuate at both ends. The flowers are produced in clusters of three at the ends of the branchlets, each group arising from a cluster of large leaves arranged in a rosette. The pedicel bears two bracteoles near its base, one sometimes a third of the way up the pedicel. Calyx, with five deltoid lobes slightly incurved, pilose on both surfaces but more heavily so outside, the margins glandular-toothed. Corolla large, 5 cm. broad, aestivation quincuncial, the petals suborbicular, distinctly clawed, quite glabrous, white, tinged with rose, especially before anthesis. Stamens twenty, the filaments nearly erect in the ten alternating with the petals, curving in the others. Anthers violet, 3 mm. long, the pollen normal in appearance. Styles five, free, the ovary with five locules each containing two superposed series of three ovules.

The fruits are abundant, developing from nearly every flower, hence they are grouped in threes at the ends of the branchlets. A second period of flowering occurs after the first, solitary flowers, which also produce fruits, appearing at the ends of the branchlets of recent growth. In these flowers the corolla persists, and as the receptacles enlarge the petals take on a greenish tint. At the beginning of autumn there is a third period of flowering, but the fruits produced do not ripen.

[1] In Bull. de la Station de Recherches Forestières pour l'Afrique du Nord, Alger, 1916.

FRUIT OF QUINCE X PEAR HYBRID

The fruit is seedless, is almost intermediate between the two parents in character, and seems to promise some commercial value. It is proposed to call it Pyronia, a combination of the two generic names Pyrus (pear) and Cydonia (quince). This is a satisfactory trade name, but will not be accepted by the botanists who, it is suggested, may call it X *Cydonia Veitchii*. Photograph actual size. (Fig. 12.)

All of the fruits which I have been able to examine were seedless. During the early development of the fruit the two rows of ovules can be seen clearly in each locule, but later when the locules have increased considerably in length they are seen to be empty.

The form of the fruit is unusual and characteristic, cylindrical, slightly longer than broad, with a short peduncle arising from a shallow cavity, the eye situated in a deep basin, open, the calyx lobes persistent. The skin is thick, rough, green or yellowish-green, abundantly covered with red dots like that of a pear. The flesh is white, granular, firm, juicy, sweet, slightly acidulous with an agreeable quince-like perfume. The season of ripening is October and November.

It is not yet possible to state with confidence what place Pyronia will take in horticulture. The fruits which I have eaten were picked before they were fully ripe; the flesh was pleasantly flavored but firm as in a half-ripe pear. When cooked, the fruits seemed to be intermediate in character between a pear and a quince.

In 1915 an attempt was made to pollinate flowers of Pyronia with pollen from various pears, but no fruits were obtained. I did not attempt to pollinate with quince pollen, though that might offer a better chance of success. The validity of the genus Pyronia, proposed by Veitch, is open to discussion, because some botanists do not admit the validity of the genus Cydonia.

The character of the ovules, six in each locule, arranged in two series of three, one superposed upon the other, seems to bring Pyronia nearer to Cydonia than to Pyrus.

LEAVES AND FLOWERS OF PYRONIA

The flowers resemble those of the quince parent slightly more than they do those of the pear parent. As the pear genus has been found to hybridize without great difficulty, Dr. Trabut suggests that many new combinations might be made in it, yielding new fruits of possible value. A hybrid between the apple and pear has already been secured, but its commercial value is not yet ascertained. Photograph actual size. (Fig. 13.)

This new genus created by hybridization may, without inconvenience, be maintained at least by horticulturists, if not by botanists who follow a fixed code of nomenclature. Botanists, it is true, have already made apples into pears, but practical horticulturists do not appreciate the scientific necessity of such a change.

In the aggregate of its characters *Cydonia Veitchii* is intermediate between Cydonia and Pyrus. It constitutes a bigeneric hybrid. Botanically this hybrid appears to be sterile, but horticul-

turally it is decidedly fruitful, yielding an abundance of well-formed, seedless fruits.

This first attempt to hybridize the quince and the pear should encourage plant breeders to make new attempts to combine the quince with those primitive species of Pyrus which have given us splendid and highly esteemed varieties of pears in such great numbers.

To Prevent Waste of Potential Ability

With a view to finding and conserving especially valuable variations in the human race, the Civic Club of Allegheny County (Pennsylvania), has established a Committee on Exceptionally Able Youths. Blanks are being sent to the school principals of Pittsburgh, with the following letter:

"The Committee on Exceptionally Able Youths of the Civic Club of Allegheny County is conducting psychological tests to find the most exceptionally gifted youths in Pittsburgh and vicinity who have dropped out of school prematurely or will do so before they have had the training appropriate to their abilities. Our work is limited to the very few individuals who have impressed the teacher or principal as having extraordinary ability, when this ability, without assistance, is not likely to receive proper development. Sometimes the families could afford further schooling and would provide it if they had tangible evidence from us of the very high qualities of the son or daughter. In other cases, a scholarship is necessary, and our recommendation will suffice to secure a number of these.

"Will you, therefore, select one or two individuals as described, who are in the eighth grade or high school or who have left school in the past few years, and send us their names and data as called for in the accompanying blank. We will then make an appointment when these individuals and others will be tested by a series of mental measurements."

The chairman of the committee, Professor Roswell H. Johnson of the University of Pittsburgh, is a eugenicist; the other members, Professors W. V. Bingham, J. B. Miner, G. C. Basset and F. A. C. Perrin, are psychologists.

A Study of Rural Epilepsy

NINE FAMILY HISTORIES OF EPILEPTICS IN ONE RURAL COUNTY. State of New York, State Board of Charities, Bureau of Analysis and Investigation. Eugenics and Social Welfare Bulletin, No. 7. Albany, N. Y., 1916.

The Department of State and Alien Poor in New York is taking an unusually intelligent view of its work, in the publication of the series of pamphlets above noted. One of its functions being established by law as the investigation of "the condition of the poor seeking aid," it is going to the bottom of the problem. The present bulletin is devoted mainly to a general review of the nature of epilepsy, in which it appears that heredity is held directly responsible for something like one-half of the cases. It has been estimated that there are in the United States perhaps as many as 175,000 epileptics—a population equal to that of the State of Wyoming. New York has a large colony for them (the Craig Colony) in Livingston County, and the families of nine inmates from a neighboring county were traced by Miss Florence Givens Smith, the results being presented in this bulletin. She has contented herself with publishing the facts, wisely refraining from any attempt to deduce laws of heredity.

CARMAN'S WHEAT-RYE HYBRIDS

Many Supposed Hybrids in the Rural New Yorker Series Show no Trace of Rye Characters—Only One Variety Originated from Real Wheat-Rye Hybrid—Descendant of This is Probably Still Grown

C. E. LEIGHTY

Bureau of Plant Industry, Washington, D. C.

ELBERT S. CARMAN,[1] editor of the *Rural New Yorker* from 1876 to 1899, achieved, in addition to editorial success, some remarkable successes as a plant breeder. His work in breeding potatoes is probably the most noteworthy, although his work with wheat and his accomplishment of crossing wheat and rye are of no mean proportions. About the time that he took up his editorial work (1876 or 1877) he turned his attention to attempts to improve wheats, first by selection, second by changing spring into winter wheats, third by crossing, and last by hybridizing wheat and rye.

In the *Rural New Yorker* of August 30, 1884, is shown what is probably the first illustration (Fig. 14) ever published of a hybrid between wheat and rye. The cross, however, had been effected by A. S. Wilson, of Edinburgh, Scotland, who presented his results April 8, 1875, in a communication to the Botanical Society of Edinburgh, without giving any illustration. The plants secured by Wilson were sterile and the hybrid therefore was not carried further than the first generation, the matter then being allowed to drop. Carman apparently knew nothing of Wilson's experiment at the time his work was done. The hybrid secured by Carman furthermore produced a few seeds, with which experimentation was continued and from the progeny of which a variety was produced and disseminated.

This cross between wheat and rye was made in the season of 1883.[2] A head of Armstrong wheat, a popular variety later known as Landreth, and today as Martin Amber, was selected for the mother, because it is a beardless, hardy, prolific variety, as much so as any of the 250 kinds tested on the Rural grounds, unless it may be the Diehl-Mediterranean, a bearded variety of hybrid origin. The anthers were extracted by the aid of a pointed stick as soon as the head was out of the boot, while they were perfectly green, and the head was covered, bound with worsted[3] for several days, when pollen of rye was applied to the stigmas from the point of a knife. This was repeated the next day, and the next, the head being again covered after each operation. Thus, before, while, and after he supposed the stigmas were receptive, pollen from rye was applied.

In this head ten more or less imperfect kernels formed which were planted late in September about a foot apart. Nine of these germinated, passed through the winter, and matured grain the next year, some being early, some medium, some late. There was no perceptible difference in the appearance of the plants during their early growth, except that some tillered more than others, but there were noticeable differences in the matured heads produced by the several plants.

From the illustrations and accom-

[1] For a short account of the life of Mr. Carman and some facts concerning his several achievements in breeding, see an article by Dr. E. M. East, in THE JOURNAL OF HEREDITY, Vol. VI, No. 2, pp. 65–67, February, 1915.

[2] The date, 1882, given in one account is evidently an error.

[3] This is according to an account given in the same year, 1883, although in 1886, in reviewing the work, it is stated, "the head was then bound with tissue paper," which was temporarily removed for pollinations.

WHEAT-RYE

This is the first illustration ever published of a wheat-rye hybrid, and represents Carman's own work. It appeared as Fig. 339 in the *Rural New Yorker* on August 30, 1884. (Fig. 14.)

panying descriptions it is seen that the heads of eight of the plants produced, excepting that plant represented by Fig. 339 which will be considered later, differed from each other (1) in awn length, some having very short awns like the mother plant, others considerably longer awns, although none could be considered as fully bearded; (2) in color of chaff, some having white, others brown chaff; (3) in size and color of kernels produced—this, however, may be due to difference in maturity; (4) in straw color, some having lead-colored, others golden-colored straw. These eight plants were in later accounts referred to as "those from the fertile plants of the original cross" and "the eight original plants resembling wheat (or the female parent) more than rye," while the remaining plant, Fig. 339 (reproduced herewith, Fig. 14) is referred to as "the nearly sterile plant" or the plant which "most resembled rye."

The best of the heads produced by these plants were selected for further growing. "The plot of about one-twentieth of an acre" where these were grown "presented the next season when the heads appeared, as varied an appearance as if kernels of all the most dissimilar wheats in cultivation had been sown." Among forms appearing were club-shaped and tapering heads, bearded and beardless heads, while the straw was yellow, dark brown or purplish. The size of heads, number of kernels produced, and size of kernels all were variable.

NO TRACE OF THE RYE

After careful examination of the available records and illustrations there appears to the writer no evidence that in these eight plants or in their progeny there existed any trace of rye. It is further apparent to one familiar with wheat-rye hybrids and with hybrids between different varieties of wheat that these eight kernels, supposed to have developed as the result of the fertilization of emasculated wheat flowers with rye pollen, must have actually resulted from fertilizations of wheat flowers with wheat pollen. How this fertilization occurred in a head supposedly emasculated before its pollen was ripe is not known, but there are several possibilities, among which is this: If, as seems probable, *worsted* was used to wrap the head after emasculation, wheat pollen may have sifted through this from other flowers nearby. It is well

A GRAIN OF ARMSTRONG WHEAT

This is the variety with which Carman made his wheat-rye hybrids; it now goes under the name of Martin Amber. Photograph much enlarged. (Fig. 15.)

known that the glumes of emasculated wheat flowers when not fertilized will remain open for some time and if not protected by pollen-proof covering will often be fertilized by pollen, probably air-borne. Again, some fault not apparent may have existed in the technique. Be that as it may, these eight plants show no signs of being wheat-rye hybrids, although at least some of them must have been hybrids between different varieties of wheat.

CARMAN'S ERRONEOUS BELIEF

Although these "eight original plants resembling wheat more than rye" cannot be admitted to be actual wheat-rye hybrids, they were so considered by Mr. Carman. In all his later reference to them they are always considered to be hybrids of wheat and rye. Of all the wheats originated by him, the varieties first to be introduced, in 1889, included two descended through continued selections from these "fertile plants," these being Nos. 2 and 3. Both of these varieties were believed to be half rye, half wheat by parentage, though they had no appearance of rye in any respect. Introduced at the same time as these two wheats were four others, known as Nos. 50, 51, 53,

A GRAIN OF RYE

It will be readily seen that there are numerous small differences between this seed and that of wheat, and that the influence of rye would be clearly discernible, if present, in a hybrid. After carefully examining the descriptions of Carman's various supposed wheat-rye hybrids, Mr. Leighty reaches the conclusion that only one of his original nine was a real hybrid, the rest being nothing but wheat. Photograph much enlarged. (Fig. 16.)

and 55, originated by crossing different varieties of wheat. These were offered in August, 1889, by J. M. Thorburn & Co., of New York City, at 25 cents for a package containing twenty-five grains, or the collection of six sorts for $1

In 1890 these six varieties were distributed free to applicants by the *Rural New Yorker*, and the varieties of special interest here were named as follows:

"No. 2 (hybrid wheat-rye) has been named

Willits after the Assistant Secretary of Agriculture.

"No. 3 (also a wheat-rye hybrid) has been named Roberts after Prof. I. P. Roberts, of Cornell University."

Although the names applied augured well for these wheats, they apparently proved of little commercial value and so far as the writer knows, are not in existence as varieties grown anywhere today.

Turning now to the "nearly sterile plant," or the one that "most resembled rye" (Fig. 14),[4] of the nine described above, it is evident from the illustration and descriptions that it was neither wheat nor rye, but had the modified characters of each. The shape and general appearance of the head, the arrangement and number of spikelets, and the glume characters were all such as are commonly found in wheat-rye hybrids. The culm resembled that of rye, except in color, having the whitish down near the head which never appears in wheat. This plant bore ten heads[5] which produced but nineteen kernels, thus being nearly sterile. All of these characters combined allow no question of this plant being actually a hybrid between wheat and rye.

MUCH VARIATION IN PROGENY

The grains produced by this plant were carefully sown and fourteen or fifteen plants resulted, which passed safely through the winter and produced altogether 107 heads, the single plants having from two to thirteen heads. As shown by an illustration which Carman published, they are all rather long, tapering, slender, and half-bearded, with more spikelets than in wheat, in their appearance giving abundant evidence of rye relationship. The characteristic hairiness on the culm beneath the head is depicted in each case, although such hairs might theoretically be lacking in some of the plants in this second generation. Some of the plants were feeble in growth and partly sterile. Others were remarkably vigorous in growth, with strong stems and many heads. Some ripened with the earliest wheats, others continued green until after the latest wheats had matured. The seeds varied in size, some being even larger than wheat, but as a whole they appeared to be wheat and yet had somewhat the shape of rye.

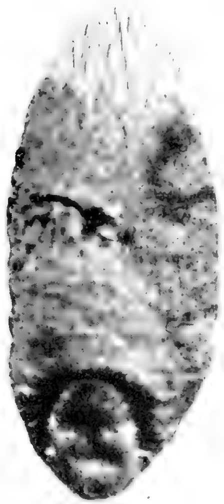
Rejecting all inferior heads, enough grain was saved from the best to plant a plat of about 1/30 (or 1/20) acre, that is, single kernels in the intersections of 10-inch squares. Regarding the crop grown Carman writes: "It is a matter of very great surprise to us that in this plat there is such a variety of heads that if evidence were suddenly placed before us that all of the varieties of wheat in cultivation sprang from accidental crosses between rye and wheat, we should accept it as in harmony with the appearance of these plants. The down does not appear upon the culms of some, while others are covered more thickly than the parent stems. The straws of some of the plants are three times the thickness of ordinary wheat straws. Some of the heads are beardless, others as much bearded as barley. Some heads are of the shape of Clawson, or the female parent Armstrong (tapering); others are club-headed, with and without beards. Some of the heads are compound. Our readers must remember that this twentieth of an acre of plants, so strongly dissimilar, all originated from a single seed, one of the ten kernels which four years ago was the result of crossing rye upon wheat."

The *New York World* in 1886 contained this description of the plants in this plat:

"Some of the plants were dwarf, not over 2½ feet high, with culms thrice as heavy as any ever seen in the pure wheats. Heads 7 inches long were not uncommon. Some were bearded heavily, others were beardless, and still others showed every intermediate stage. Some were club-headed, with breasts or spikelets densely crowded towards the top. Some bore compound spikelets, that is, two breasts growing instead of one, and the head partially double-breasted on each side of the rachis. Some heads were shapely, others twisted, with long, curly awns and culms as crooked as the heads. Some heads were larger and contained more kernels than any wheats we have ever seen growing in this climate. Others were feeble, narrow heads, scarcely 2

[4] "The portrait is true, except that the beards are nearly twice as long as shown." (*43*: 557.)

[5] "A later account states "14 heads" and "17 grains."



A WHEAT-RYE HYBRID

This grain is one of four produced on a wheat head from flowers cross-pollinated by C. E. Leighty. Although it is a genuine hybrid, it shows no traces of the influence of the rye (male) parent. The hairs at the top have been slightly retouched to make them more visible. Photograph much enlarged. (Fig. 17.)

inches long. The straws were all colors, from yellow to dark purple. They were of all thicknesses, from the size of rye to that of a small slate pencil. Some were densely downy, others smooth. Some were wiry and strong, others weak.

These plants were maturing variously, some with rye, some with wheat, while many were still perfectly green, with a good promise of not ripening at all. These strange plants, all from one seed, vary so remarkably, are so entirely different from either wheat or rye, that nothing short of seeing them can give the reader a good idea of them or enable authorities on grasses to intelligently consider the matter."

Long and faithful effort was expended in the task of fixing selections from the wheat-rye hybrids. In 1892 this statement was made concerning the progress up to this time:

"The illustration (Fig. 226) is a photo-engraving of typical heads of what we have alluded to as those hybrids between rye and wheat which are distinctly neither wheat nor rye; in other words, they are new grains. For some years we despaired of ever fixing them. Seeds from bearded, long, narrow heads, as shown at No. 1, were just as likely as not to produce beardless, club heads as shown at No. 6, and all the intermediates as shown at Nos. 2, 3, 4, and 5, though the heads of the same plant varied only in size, the same as fixed varieties vary. Again, the downy stem was inconstant. Seeds from plants with stems as downy as the chaff of velvet-chaff wheat would produce culms without down, though we have never known a smooth stem to produce one with down. It will be remembered that the stems of the rye for an inch or so below the head are always fuzzy or downy, and that this peculiarity in the rye-wheat hybrids must come from the male parent, rye. The quantity of down, however, is variable. Some of the stems of the hybrids are densely downy or plush-like, while others are just like the stiffer fuzziness of rye. Here again the stems of a plant are all alike. It never happens that one or several stems of a plant are fuzzy while the others are not.

"The heads shown in the illustration are those of varieties which seem to be fairly well fixed. The beard or beardlessness, the downy stems, and the general shape are quite constant. They vary chiefly in the size of heads, some plants from the same seeds yielding plants some of which bear heads twice as long as others. Selections are now being made to secure the largest heads. The grain itself is just as distinct as the heads. The kernels are long, of a dark amber color, while there is so little starch in them that they seem almost translucent like horn. It is reasonable to assume that such grain would make a highly nitrogenous flour. Of this, however, nothing is positively known.

"The down extending 2 inches or more below the heads is not apparent in our illustrations."

In 1892 there were introduced three new varieties originated by Mr. Carman,

these being Nos. 1, 4, and 52. Nos. 1 and 4 are described as follows:

No. 1.—By parentage half wheat, half rye. Mother parent Armstrong. Heads compact, symmetrical, pointed, bearded; brown chaff. Three grains to a spikelet, eight spikelets to a side. Kernels hard, reddish or dark amber. Straw very strong and of medium height. As early as rye. Thought to be very hardy.

No. 4.—By parentage half wheat, half rye. Mother plant crossed progeny of Armstrong. Heads symmetrical and absolutely beardless; brown chaff. Three grains to a spikelet, eight and nine spikelets to a side. Dark amber kernels. Stems very strong. Ripens with rye.

No. 52.—Originated as a pure wheat cross.

From the data given it cannot be ascertained whether these two varieties were actually descended from the true wheat-rye hybrid or whether they were descended from the supposed hybrids as were No. 2 (Willits) and No. 3 (Roberts).

No. 1 apparently survived longer than any other of the varieties introduced up to this time, as it was offered to the trade by the seedsman introducing it up to and including 1898, while in the meantime the others had been dropped from the lists. It is not known to the writer that any of these varieties are now grown, although a variety called "No. 4" was seen growing in New York State in 1912, the characters of which agreed with the meager description obtainable of the variety.

In 1894 two further introductions of wheat varieties were made, these being No. 57 and No. 6. Although No. 57 was not originated as a cross with rye, it is perhaps the best of all introductions made by Mr. Carman, and a description is appended.

"Peter Henderson & Co., of this city, now offer for the first time two of our wheats which the firm has kindly named Rural New Yorker No. 57 and Rural New Yorker No. 6. The first is a heavily bearded variety, the parentage of which is one of our crossbred varieties fertilized with a crossbred of Velvet Chaff. The down ("velvet") upon the glumes is very light, though perhaps heavy enough to resist the green fly, but not dense enough to invite mildew, which is often an objection to Velvet Chaff. We have raised our hybrids and crossbreeds only upon very small plats. From such trials, the No. 57 appeared to be a heavy yielder, with large, symmetrical, heavily-bearded heads, and tall wiry culms. It is a strong, vigorous grower, stools freely, and has never been winter-killed.

"The Rural New Yorker No. 6 is one of the rye-wheat hybrids, though all appearance of rye has disappeared except that the culms just under the heads are now and again downy as in rye. The downiness of the stem is variable. We have tried by selection for many years to fix it without any approach to success. Of all our rye-wheat hybrids, the downy culm is permanent in but one, and that resembles rye in several other respects. The Hendersons have found that No. 6 'succeeds and produces heavy crops on poor, thin land, where pure wheat could not be successfully or profitably grown.' This surely is a most valuable characteristic. Figure 165, page 630, shows the plant, one head, and several kernels."

THE ONLY REAL HYBRID

From this description and from a statement made elsewhere concerning its origin, it seems that No. 6 is actually descended from the true wheat-rye hybrid obtained in 1883. It is noteworthy for this fact, since it is the only variety introduced by Mr. Carman whose record, so far as determined by the writer, clearly indicated such origin. This variety is also still being grown, at least a variety bearing this name is now included among the wheat varieties of several experiment stations.

In common with the breeders of his day, Carman believed that the parents of a hybrid were equally represented in all self-fertilized individuals of subsequent generations. There might be variation in form but not in composition. He thought that by again fertilizing with rye pollen any plant of his first or later generations of wheat-rye hybrids, all intervening generations having been naturally self-fertilized, plants three-quarters rye by parentage would be secured. These plants or their

progeny in turn being again fertilized by rye pollen would produce plants seven-eights rye by parentage. By continuing this process plants fifteen-sixteenths rye, and so on in the same fractional series, could be secured, the further generations thus all the time approaching pure rye in composition. The laws of Mendel were not then known.

Actuated by the desire to produce rye in this way, and thus, if possible, to throw some light on the origin of wheat and rye, Carman, with true scientific spirit, made the crosses as required by the theory, carefully year after year. A head on one of the eight "fertile plants of the original cross" was emasculated and pollinated with rye pollen in 1884. One kernel resulted, which grew and produced twenty or twenty-two heads on which were three kernels. This was apparently an actual hybrid of wheat and rye, the female parent being wheat, as pointed out above. It was considered to be, however, three-quarters rye. These three kernels grew and two produced plants, but their subsequent history cannot be accurately followed from the accounts given.

TRIALS COME TO AN END

A head of one of the hybrids most resembling rye was emasculated and pollinated with rye pollen in 1885. On this, seventeen kernels were formed, which resulted in fourteen plants the next year, these being considered as three-quarters rye. By following this system with one (or possibly both—the account is ambiguous) of these lots of supposed three-quarter rye plants "several plants were produced with a supposed parentage seven-eights rye," and at least one with a supposed parentage of fifteen-sixteenths rye. The supposed fifteen-sixteenths rye plant was entirely sterile, and the supposed seven-eighths plants were nearly all sterile. In spite of these discouragements the experimenter continued until finally he writes: "This trial has come to an end through necessity or through causes over which we had no control, viz., absolute barrenness of the latest progeny." The belief is expressed that "any endeavors to originate a hybrid which shall be more than three-quarters rye will prove ineffectual." No variety of supposed three-quarters rye parentage was apparently ever actually introduced, although one known as No. 11 was placed for propagation and introduction, but no later account of it is found.

In 1897, several years after his different wheats had been distributed, some one asked "Are there any of the Rural hybrid wheats that you believe to be ahead of all other kinds in hardiness and prolificacy?" The candid spirit of the man is shown in the reply: "No, we have not received any reports which would justify us in placing any of the Rural hybrid wheats above the popular kinds of today. . . . Of the crossbred wheats which have originated at the Rural Grounds, the R. N. Y. No. 57 is very promising." And so the matter stands.

Correction

Through an editorial blunder, the paper on Pollinating Fruit Trees, in the last issue of the JOURNAL OF HEREDITY was credited to Leslie Gordon Corrie. The paper was written by, and should have been credited to, Reg. W. Peters, director of the Queensland Acclimatization Society, Lawnton, Queensland, Australia. Mr. Peters was formerly associated with William Bateson at the John Innes Horticultural Institution, Merton, Surrey, England, and took up the work in Australia last year. Members should note this correction in their copies of the August issue, in order that they may not repeat the error in making citations of Mr. Peters' paper at any time in the future.

COLLARETTE FLOWERS

T. D. A. Cockerell, *Boulder, Colo.*

THE first collarette dahlia was exhibited in 1900, and placed on the market in 1901. This apparently unique variety, called President Viger, possessed the peculiarity of having supplementary lobes, of variable shape, at the base of the ray-corollas. These lobes or processes being white or nearly so, against the dark crimson background of the rays, were very effective, and the variety was at once recognized as an important addition to horticulture. During the last fifteen years the original collarette dahlia has been crossed with numerous other varieties, giving a long list of collarettes, of various colors.

It might readily be supposed that the collarette form was something absolutely new when it appeared in the dahlia less than twenty years ago. Experience with various compositae throws doubt on such an opinion, because we find that certain variations crop out here and there in diverse but more or less related genera, at different times and places. The variations of *Dahlia*, *Helianthus*, *Ratibida*, etc., run so closely parallel that whatever occurs in one we begin to expect in the others, while it appears increasingly probable that the whole group has been producing the known series of variations at intervals during past ages. The "origin" of a variety, as recorded, thus has to do only with the first occasion when it chanced to be detected on coming to the surface, as it were, of the stream of heredity.

The first collarette sunflower, of the chestnut and vinous forms of *Helianthus annuus*, was obtained in our cultures at Boulder, Colo., in 1915. Quite unexpectedly, a considerable number of plants showed this character, but the supplementary lobes were narrow and very variable, not nearly as showy as in the dahlia. The essential structure was, however, quite the same. This year we have a piece of ground devoted to collarettes, and by continued breeding and selection it is probable that the type will eventually be much improved.

The evidence seemed to indicate that the collarette sunflower had arisen for the first time in cultivation; but on September 24, 1915, I found a wild plant (*H. annuus lenticularis*) in Boulder, having genuine collarette characters. There was only one head on the plant, the last of the season, and in this two of the rays were tubular. There is apparently a connection between the variation with tubular rays and the collarette, as is especially indicated by *Arnica pedunculata* Rydberg[1] var. n. *tubularis*, found by my wife at Boulder, June, 1915. In this variety the ligules are tridendate at the end, as in the typical form, but are variably tubular below, with a liguliform process on each side of the mouth of the tube. From this condition to a collarette *Arnica* would be no great step.

The latest and in some ways most surprising collarette to be discovered is in the long-headed cone-flower, *Ratibida columnifera*.[2] This form (var. nov. *appendiculata*) was found by the writer at the base of Flagstaff Hill, Boulder, July 8, 1916. The rays possess long appendages, usually a pair, arising from the throat.

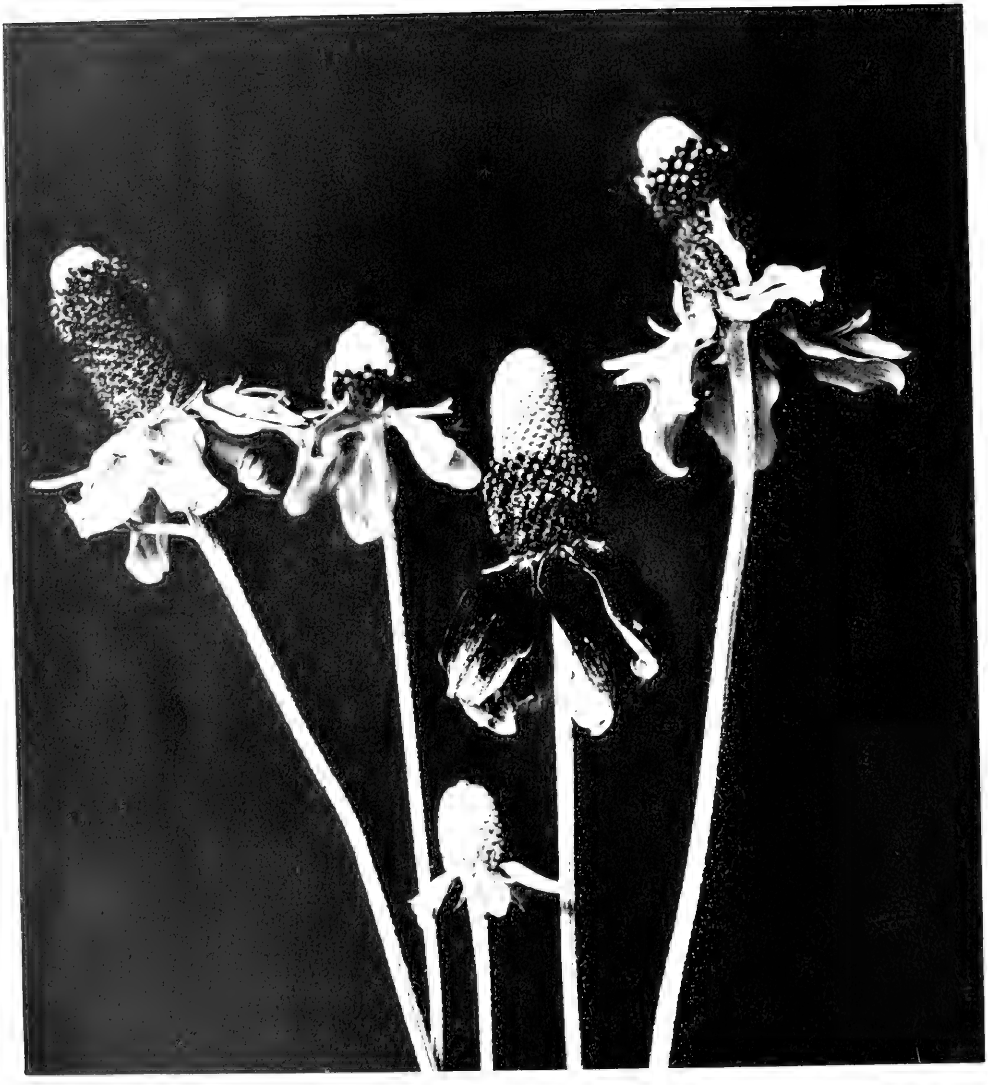
Although *Ratibida* is so different in many respects from *Helianthus*, having a long conical receptacle, the pappus a rudimentary crown, and the very peculiar disc-bracts with a long dark crimson spot on each side, the variations run parallel in the most astonishing way. The form with wholly or partly chestnut red rays, parallel with the red sun-

[1] *Arnica pedunculata* is common at Boulder. Apparently Nelson is correct in considering *A. monocephala* Rydb. to be a form of *pedunculata*, but wrong in referring them to *A. fulgens*.

[2] Wooton and Standley write *columnifera* in place of *columnaris*, the former name having a year's priority.

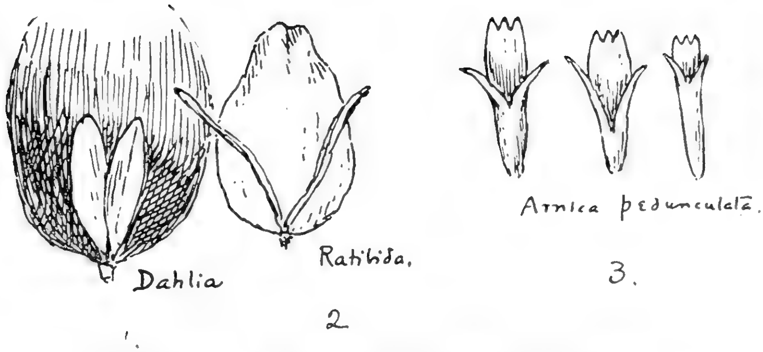
COLLARETTE SUNFLOWERS

From the original lot in cultivation at Boulder. The upper one is vinous, the lower chestnut red. The first record, with this illustration, was made in the *Gardeners' Chronicle* (London), November 6, 1915, p. 295. (Fig. 18.)



COLLARETTE CONEFLOWERS

The coneflower (*Ratibida columnifera*) is common on the Western prairies; but the specimens here shown are the first ones ever brought to light which are characterized by a collarette. The dark-rayed head in the middle is var. *pulcherrima*. (Fig. 19.)



ABNORMAL RAYS IN COLLARETTE FLOWERS

1. Ray of the first collarette dahlia (President Viger) showing the additional lobes described in the text.
2. Ray of the collarette coneflower with long, narrow, additional lobes.
3. *Arnica pedunculata* var. *tubularis:* variation in rays, showing appendages at throat of tube. (Fig. 20.)

flower, was described by DeCandolle under the name *pulcherrima* as early as 1836. This year Miss Hazel Andrews has found at Boulder a variety with pale yellow rays, like the "primrose" sunflower, and if this is crossed with *pulcherrima*, the F_2 will certainly include a vinous *Ratibida*. Varieties of *Ratibida columnifera* with twin or double heads, with short rays, with tubular rays, and with rays incised at the end, all exactly parallel variations of the *Helianthus annuus* group.

There is no reason for ascribing all these parallel variations to "reversion" to some common ancestor possessing such characters; we must rather suppose that the genetic composition of the whole group of genera is such that these particular changes arise from time to time, without reference to the environment. Whether, in any given case, they are due to original variations of the germinal substance, or are due to the cropping out of characters for which determiners have existed in the chromosomes for ages, may be extremely difficult to decide.

Annual Meeting of the A. G. A.

The next annual meeting of the American Genetic Association will be held in connection with the American Association for the Advancement of Science, in New York City in the week following Christmas. It is anticipated that that week will bring together one of the largest gatherings of men of science that has ever met in the United States. Members who desire to present papers at the meeting of the American Genetic Association should notify the secretary as far in advance as possible. Papers which are suitable will be published in the JOURNAL OF HEREDITY; others may be published by the authors elsewhere. Further details will be announced as soon as possible.

Breeding Citrous Fruits

All possible combinations of citrous fruits are being made at the Citrus Experiment Station, Riverside, Cal., according to Director H. J. Webber. Among the most important are: (1) Combinations of the mandarin and the tangerine with the good varieties of the common orange to obtain large fruited varieties with the easily removable skin of tangerine and the quality of common orange. (2) Cross of tangerine and blood oranges to secure blood tangerines. (3) Crosses of lemon with blood oranges to secure blood lemons. (4) Crosses of blood oranges with pomelo to secure blood pomelos and the like.

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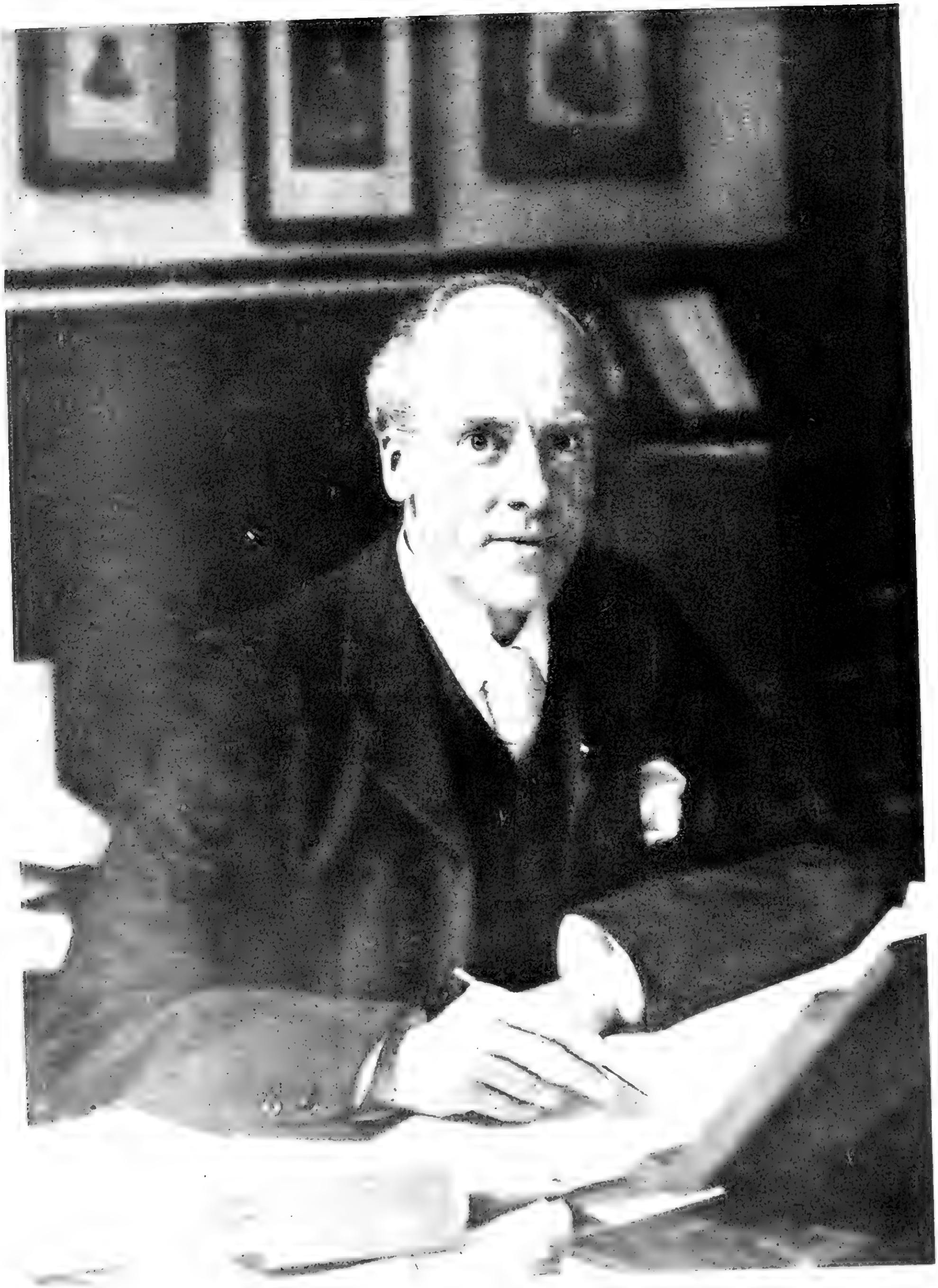


KARL PEARSON

The name of the director of the Galton Laboratory of National Eugenics, University of London, is probably familiar to all readers, but few know what he looks like. For many years he has been the leader of a movement to apply statistical methods to biological problems, and he and his students have made many notable contributions to the study of heredity and variation. Since the outbreak of the war, Prof. Pearson's biometric work has been largely suspended, the staff of his laboratory having for some time placed its services at the command of the government and devoted itself to keeping track of unemployment in Great Britain.—Frontispiece.

PEAR BREEDING

Valuable Group of Fruit Trees Lends Itself Readily to Cross-Pollination, and Valuable Results Are Possible—Considerable Time Needed—Methods of Operation

HYBRIDS are easily made in the pear genus (in which many botanists now include the apple, quince, medlar, etc.), and many of these hybrids offer valuable commercial possibilities. As trees of this kind are accessible to nearly every one in the temperate regions of the world, it is a particularly good group for amateur plant-breeders to work with, provided they are not in a hurry.

The European pear (*Pyrus communis*) is found throughout southern Europe and Asia, being indigenous as far east as Kashmír. It has been cultivated since the dawn of history, and selection of the best, with such cross-pollination as has been done by nature, seems to be responsible for the production of such superb pears as those which are known in Europe as the *beurre* type, and which are represented in the United States by the Bartlett.

Pears of this kind were among the first fruit trees imported by the early settlers in North America. Some time before the middle of the nineteenth century a very distinct species, the Chinese Sand Pear (*P. sinensis*) was introduced. The fruit of this species is considered good by the Chinese and Japanese, but it is hard and lacking in flavor, and full of stone-cells. When one's teeth crunch into these, it is not difficult to understand why this variety got the name Sand Pear.

Peter Kieffer, of Roxborough, Philadelphia, an Alsatian gardener, who died in 1890, grew some of these Sand Pears, according to L. H. Bailey, "and sold the seedlings as ornamental trees, for this species is of very distinct and handsome growth and the fruit is ornamental and fragrant. Alongside the Sand Pears were Bartletts. Among one of the batches of seedlings from the Sand Pear he noticed a plant with different foliage, and this he saved. Its fruit was found to be superior to the Sand Pear, and it was introduced as the Kieffer. The Kieffer pear is now very popular in many parts of the country because of its great vigor, healthfulness, productiveness and the keeping quality of its fruit. In point of quality the fruit is distinctly inferior, but it meets the demands of the market and is an excellent fruit for canning."

There is no doubt that the Kieffer, which is second only to the Bartlett in popularity in the United States, is a hybrid of the Bartlett and the Sand Pear. While the circumstances of its origin, as told by Bailey, would not be conclusive on that point, there are plenty of other crosses of a similar nature, many of which are in the trade. The Le Conte is perhaps the best known of these hybrids, after the Kieffer.

ROOM FOR NEW VARIETIES

One who undertakes pear-breeding need not expect to produce, at the first attempt, a hybrid that will supplant the Kieffer, although many connoisseurs have declared that it would not be hard to surpass the quality of that popular variety. There is need of varities that will be hardy and disease-resistant, and that will extend the fruiting season, and any one who undertakes the task of pear-breeding intelligently and persistently has a chance to succeed.[1]

[1] A cross between the pear and quince was described by Dr. L. Trabut in the last issue of this Journal. The Office of Seed and Plant Introduction, U. S. Department of Agriculture, Washington, D. C., has brought in many wild species of Pyrus for breeders, and any experimenter could probably secure specimens from it; but as is pointed out in the present article, more is to be

"In the improvement of any fruit," says W. R. Ballard of the Maryland Experiment Station,[2] "an intimate knowledge of varieties is essential to intelligent effort. Such information should include not only the adaptability of varieties to climatic conditions, habit of growth, season, productiveness, character and quality of fruit, but should also include as far as possible information concerning disease resistance and historical data in regard to parentage. The great majority of varieties grown in this country are undoubtedly of hybrid origin. This is due to the promiscuous cross-pollination carried on by bees and other insects. This fact makes the value of a variety for breeding purposes somewhat problematical since many characters show up in the progeny which cannot readily be detected in the parents. This hybrid nature, however, works to the advantage of the breeder of orchard fruits for wide variation occurs in the first generation, so that he does not have to wait until the second generation for such results, as would be the case were he working with pure strains. Investigations here and at other stations indicate that the greatest improvement is to be secured by using for breeding purposes only the best of the varieties now in existence. Only occasionaly is it necessary to depart from this rule in order to utilize some particular character of an otherwise inferior variety.

"Since pollination can be done only during a comparatively short blooming period, it is essential to be thoroughly prepared for work when the time comes. There is more or less variation in the time of blossoming of different varieties, although in abnormal seasons all varieties have been known to bloom at about the same time. Advantage can often be taken of this variation by using the early bloomers as the male parent. This enables one to collect pollen in workable quantitites before the buds of the later varieties are ready to be pollinated. Weather conditions are also more likely to be favorable for pollinating work at this later period.

MAKING POLLINATIONS

"Normally the anthers burst and the pollen is shed shortly after the blossom opens. This usually takes place early in the day. In cross-pollination it was formerly customary to break off recently opened blossoms and brush the stigmas of the emasculated buds with the opening anthers. There was always danger in this method that bees or other insects had already visited the flowers leaving a deposit of foreign pollen in the blossom used for pollinating. Where the purpose was simply to get variation without regard to parentage, this method worked very well in a small way, but where a study is to be made of the laws of inheritance more accurate methods must be followed.

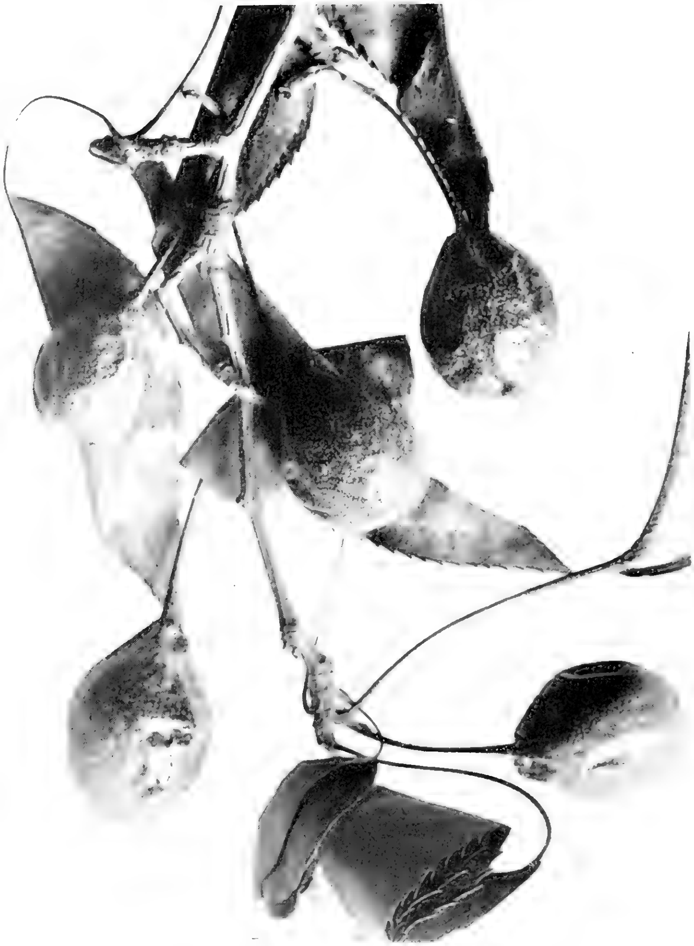
"A simple method used by the author to insure a good supply of pollen is to gather a number of buds which are just ready to open but not far enough advanced to allow the entrance of insects. This would usually be about a day before they would normally open. By grasping the petals between thumb and forefinger, they can easily be rubbed off, together with anthers. These are then collected on a newspaper and after the loose petals and other waste materials have been sifted out, the anthers are transferred to glass dishes (petric dishes are excellent for this purpose) and placed in a moderately warm dry atmosphere. The anthers will soon burst open releasing the pollen grains. When the pollen becomes dry it is protected from moisture until needed. Handled in this way it may be kept for several days, although it is always advisable to use it as soon after being collected as convenient. Should doubt arise as to it viability, a test of its germinating power is made by placing a small quantity of

expected by crossing varieties that have already been improved. The wild species are of value mainly as stock for grafting, a Chinese species known as *Pyrus davidiana* having proved particularly valuable by its hardiness and vigor.

[2] Ballard, W. R., Methods and Problems in Pear and Apple Breeding. Maryland Agricultural Experiment Station, Bulletin No. 196, College Park, Md., April, 1916.

THE BARTLETT PEAR AND ITS ANCESTOR

The wild pear which grows throughout the southern parts of Europe and Western Asia was brought under cultivation in prehistoric times, and has evolved into the delicious fruit of the Bartlett type, a small specimen of which is shown below. The wild fruit, shown above, is not actually the *Pyrus communis* which is the reputed ancestor of the Bartlett, but the Snow Pear (*P. nivalis*), the fruit of which is practically identical. The leaves differ, but the differences are so slight that some botanists have considered the Snow Pear nothing more than a variety of *P. communis*, a good photograph of which was not obtainable. Photograph (natural size) from the U. S. Department of Agriculture. (Fig. 1.)



THE CHINESE SAND PEAR

This hard-fruited little species is common in China and Japan, where it has been considerably improved in size but not very much in flavor. It was introduced to the United States as an ornamental tree, and accidental crosses with Bartlett Pears resulted in some valuable new varieties which are widely grown in the United States. Photograph (natural size) from the U. S. Department of Agriculture. (Fig. 2.)

pollen in a 2% solution of sugar and keeping it at a moderate temperature. If upon examination under a microscope after a few hours, the pollen grains are found to have germinated and sent out their pollen tubes, it is usually safe to use the remaining pollen for crossing. Each kind of pollen is carefully labelled in order that no uncertainty may arise as to its source.

"In order to effect a cross the buds to be pollinated should first be emasculated, so that self-fertilization may not take place. The following method has been used by the writer for several years with pears and apples with excellent results. The bud is held firmly between the thumb and forefinger of the left hand. Emasculation is then accomplished expeditiously by inserting

THE KIEFFER, A VALUABLE CHANCE HYBRID

The popular Kieffer pear, a fine specimen of which is here shown, natural size, originated as an accidental cross in a Philadelphia nursery half a century or more ago. Its parents were the Bartlett pear and the poor Chinese Sand Pear shown in Fig. 2. The Le Conte and several other less-known varieties have come from the same sort of hybridization. Although many epicures have condemned the quality of the Kieffer, it holds its place as one of the most widely grown varieties in the United States. Photograph from the U. S. Department of Agriculture. (Fig. 3.)

a well-sharpened scalpel into the side of a bud just below the calyx. Then by giving it a quick upward jerk, the whole corolla is removed, carrying with it all the anthers. Pear buds are especially easy to work in this manner, but in the apple the abundant pubescence soon dulls the scalpel necessitating frequent sharpening for the best results.

FEW BUDS REMOVED

"Fruit buds of the pear and apple are borne in clusters of six or more. Ordinarily only one or two of these buds set fruit and come to maturity. In hybridizing work the question arises as to the number of buds in the cluster which should be emasculated and pollinated. The central bud develops previously to the others so that it is safer to remove it. The best results have followed the working of the majority of the buds in the cluster, since the emasculation can be done in about the length of time it would take to remove the extra buds, and pollination requires very little longer time. Sometimes several clusters are close together and may be enclosed in a single bag. As many as eleven fruits of the Seckel pear have been secured under one sack in this way.

"Until recently it has been customary to emasculate the buds, cover at once with a paper sack and leave for a day or so until the stigmatic surface reaches a receptive condition before pollination is done. The writer has found that equally good results are secured by pollinating at the time of emasculation, provided this operation is delayed until the buds are nearly ready to open. Pollen will remain on the stigma in good condition until it can germinate in the nectar which is secreted on the stigmatic surface. This eliminates the extra work of removing

PREPARING TO POLLINATE PEARS

The flower may be held as shown above, and its top jerked off with a sharp scalpel. This removes all the pollen-bearing parts of the flower, but leaves the stigma and ovary. There is then no danger of self-pollination, which would result in a mix-up of heredity. A corolla which has been removed is shown in the upper right-hand part of the picture; a little to the left, below it, is a cluster of flowers which have been emasculated and are now ready to be cross-pollinated. The pollen must be secured from other flowers by removing the buds a day before they open. Four such buds are shown in the photograph. The anthers are taken from them and kept in some convenient way; the glass petrie dish full of anthers, shown at the bottom of the above picture, is much used. The tag illustrates how crosses should be marked to avoid confusion. Further details of the operations are given in the text. Photograph from Maryland Experiment Sta. Bull. No. 196. (Fig. 4.)

the sacks for pollination and replacing them. A camel's hair brush is frequently recommended for applying the pollen but the writer has found the tip of the finger to answer the purpose more satisfactorily."

After pollination the buds are covered with manilla paper sacks and carefully labelled. Time is saved by giving the labels simply a serial number for identification. Other data of the cross are kept in a notebook. In recording the cross it is customary to write the name of the female parent first, followed by that of the male parent, *e. g.*, Seckel x Kieffer.

SETTING OF THE FRUIT

"Not much is yet known about the sexual affinities of our cultivated varieties of pears and apples. Unfavorable seasonal conditions and some unknown factors, probably of a physiological nature, make this subject a confusing one. The writer has often noted trees loaded with fruit blossoms which set an extremely small amount of fruit, notwithstanding the fact that what are generally considered favorable weather conditions for pollination prevailed. Such failures do not appear to be due to lack of pollen, for even where buds are thoroughly pollinated artificially, the percentage of fruit set seems to correspond with that of the tree as a whole. It is true that certain crosses generally give better results than do others. Pears generally set a higher percentage of fruit than apples whether pollinated naturally or artificially. Of the total number of pear buds pollinated in our work, the percentage which set fruit was 24.2, while that of the total number of apple buds pollinated was 9.9. The variation in the different crosses is quite noticeable, some consistently failing to set fruit, while others set well. One of the most remarkable sets of fruit was recorded in the spring of 1910 when 651 fruits of the Seckel pear set, out of a total number of 807 buds pollinated with Kieffer pollen. This amounts to about 80.6 %. Over a series of years, however, the average drops to 37.8 %.

"After the June drop the paper sacks are removed and a record made of the number of fruit set. The fruit is then covered with bags made of mosquito netting which allows a good development of the fruit and prevents loss, should it mature and fall off before being picked. In cases where specimens have fallen out of the sacks accidentally, the scar which results from removing the calyx in emasculation often furnishes a convenient mark of identification. A few instances were noted where the development in the paper sacks was hindered by infestations of aphids. Protected from their natural enemies the aphids multiplied enormously until the sacks contained great masses of the insects.

GATHERING THE SEED

"As the fruit ripens it is gathered and the seed removed when fully matured. The number of seeds produced by different varieties varies considerably, a fact which may often be turned to advantage by choosing prolific varieties as female parents.

"The seeds are kept in a dry place until time to plant. After trying various methods the writer has found that one of the most satisfactory ways of handling the seed is to plant them in thumb pots or flats in light well-drained soil and place them in a cold frame early in the fall. There is always a certain percentage of loss of pots from freezing and bursting so that flats are more economical. To prevent getting the seed from the different crosses mixed, the greatest care must be exercised. No one, who has not worked with things of this sort, can appreciate how easy it is to get the labels or seeds misplaced.

"Early in March the seeds are removed to the greenhouse and are given gentle heat. Germination usually takes place rapidly under such conditions. It is essential to water with great care at this stage to avoid loss from damping-off fungi. Slugs seem to be extremely fond of the young seedlings and they should be guarded against. A trail of some such material as soot, lime or kainit surrounding the pots or boxes

makes a good deterrent. Seedlings in flats are potted off after the first two or three true leaves appear and are then transplanted to the nursery row when danger of frost is over.

ELIMINATION OF UNDESIRABLES

"Since fruit trees are grown primarily for their fruit, it would be highly desirable from an economical standpoint to eliminate undesirable seedlings at an early age. After considerable correspondence with plant breeders, the writer reached the conclusion that, in the present state of our knowledge of the subject, no satisfactory basis of elimination has yet been worked out. In view of the importance of determining whether there are correlated characters which can be used for that purpose, it seems desirable to grow all seedlings up to the fruiting age in order that tree and fruit characters may be compared. The prevailing opinion seems to be that the best results are obtained from seedlings showing a close resemblance to the smooth appearance of our improved forms. In regard to this point, Joe A. Burton, who is in charge of the apple breeding work of the Indiana State Horticultural Society, states that he inquired of a prominent plant breeder if anything could be done in selection. Mr. Burton writes:

> The following is his reply: "Prominent buds, large, smooth, regular, glossy leaves, large leaf stems, short distances between buds and a compact sturdy look, are the best indications of a good apple among seedlings." I was greatly pleased with this information because it coincided with what I and my friends already believed. So on one occasion when the Horticultural Board of the State, all experienced horticulturists, visited the Experimental Orchard, I asked them to select each a tree that he thought most promising. One tree all agreed would surely be grand. As they came into bearing nearly every tree was a sweet variety, and the special tree a very small worthless variety. Not a selected tree was of any worth. I had refrained from cutting out trees that I was sure were worthless, because I had had no experience. It was well that I did. We did not know how to select. . . . Consider a few well-known varieties. Grimes and Rambo are thorny. Rambo is especially unpromising in bud appearance. Benoni, the king of summer varieties, is very unpromising both in tree and bud. Jonathan grows so straggling that nurserymen don't like to grow it.

"At best it is a long time to wait for seedling trees to come into bearing. Various expedients have been tried to shorten this period. A number of seedlings were top-worked on dwarf trees but the results were not encouraging The top-working entailed a good deal of labor, and where several kinds were placed on the same tree it was almost impossible to keep track of them. Besides this many of the seedlings fruited almost as early on their own roots.

"Girdling was another method tried. The first plan used was to remove a ring of bark but some of the wounds did not heal readily and later it was found more satisfactory to check the flow of sap by wrapping the branch with a strand of fine wire. When this was done on trees 5 or 6 years old about the last of June very good results were secured. One drawback to girdling is the production of numerous water sprouts just below the point girdled. These water sprouts are very susceptible to the fire blight. Summer pruning helps somewhat in controlling them, but it must be done with care or it will only serve to spread the blight around. Frequently the first blossoms appear on the terminal shoots so it seems desirable not to prune these back severely. Even with these expedients, however, one can hardly expect any very great results in breeding work with pears and apples in less than ten or twelve years."

Tobacco That Will Burn

"Fire-holding capacity" is the basis for breeding tobacco in Germany, as described by D. Hoffmann in *Fühling's Landwirthschaftliche Zeitung* (64, pp. 366–371). The duration of glow of 150 unfermented leaves was found to range from 10 seconds to the complete incineration of the leaf. The capacity for holding fire appears to be an inherited character, but there are some difficulties connected with producing leaves that burn as well as is desired.

FECUNDITY AND STAMINA

Very High Egg Yields Do Not Seem to Result in Any Deterioration of Stock, and the Birds Produced in Such Strains Are up to the Average in Vigor—Selection Necessary[1]

A. A. Dunnicliff, Jr.
New South Wales

THE danger signal has been raised by more or less authoritative critics in various parts of the world that the striving for higher and higher egg production, and breeding from hens of great fecundity, can only result in degeneration of the constitution of the stock and consequent disaster to the breeder.

Egg-laying competitions have been pointed to as exercising a dangerous influence in this direction by fostering and stimulating the breeder's efforts to "climb the ever-climbing wave" of high records, at the expense of the vitality of the layers and the stamina of their progeny. Now, in New South Wales, where this work has been in continuous progress longer than in any other part of the world, we know that the attainment of high records has never been subordinated by the controlling committees to practical and utilitarian considerations, as the restrictions as to quality, size of eggs, and weight of the pullets testify. The great records obtained in these competitions have been produced on the plain ration of the ordinary poultry-farmer, without any forcing foods or adventitious aids, consequently there is nothing in them that is fictitious or beyond the scope of the commercial poultry-keeper. They, therefore, offer a sound basis for the consideration of the question at issue. The second and third year tests have provided unique opportunities for observation as to the relation between fecundity and stamina. Further, the following up of breeders' results from competition hens of great prolificness furnishes facts which dissipate theories as to the inroads which heavy laying makes upon the constitution of the hen and her power to transmit stamina to her progeny.

RECORDS OF CHAMPIONS

It is instructive to trace the results of breeding from hens that have put up high records in these competitions. Take the pen of White Leghorns which won the second two-years' test with 1,474 eggs in the first year and 1,150 eggs in the second year, and that which won the fourth two-years' test with 1,324 eggs in the first year, and 1,045 in the second year. Both belonged to the same owner and were bred on the same lines. These hens, I am assured by the purchaser of them, proved entirely satisfactory as breeders, both as regards fertility and the constitutional vigor of the progeny. The stock I have seen from these hens fully bears this out. Mated to cockerels of a strain with many years' conspicuous competition performances, the tendency to weakness which has been pointed to as a concomitant of high fecundity could be looked for in both lines of blood did it exist. On the contrary, even in the fourth and fifth generations the resultant stock shows a high average robustness that leaves nothing to be desired, a fact that is emphasised by pens of the direct progeny in the fourteenth and current (fifteenth) competitions.

[1] This paper was awarded first prize by the committee of management in connection with the eighth annual conference of poultry farmers, held at the Hawkesbury (N. S. W.) Agricultural College on June 17, 1916. It is here reprinted from the *Agricultural Gazette* of New South Wales, July 3, 1916, Vol. XXVII, part 7, pp. 507–510.

Another example may be cited in the White Leghorn hens which won the 1912-13 competition with 1,461 eggs, and the following two-years' test with 1,091 eggs in their second year without replacement of a bird. These hens subsequently in the breeding pen reproduced in the constitutional vigor of their progeny the inherent vitality which sustained their great laying in the competition. It was the owner of these hens who, with other birds of precisely the same blood, achieved a world's record in the 1914-15 single-pen test. The four best hens in that group, with certified individual records of 267, 270, 270, and 288 eggs, when used for breeding last season, gave every evidence that constitutionally they had not suffered under the strain of this great production, which represented eight times their own weight in eggs. The owner and breeder of these exceptionally prolific hens emphatically states: "I notice absolutely no deterioration in stamina or constitution in the progeny. I never had a healthier or more vigorous lot of youngsters. They hatched well and reared well." Six of the daughters of these hens are competing in the present competition, and physically they compare in every respect with their mothers.

Again, the results of breeding from the three best hens that gave the highest returns in the 1913-14 single-pen test have been similarly satisfactory. In the first season the fertility was good, the chickens were sturdy, and they developed to maturity with a high average in full possession of soundness and vitality. A cockerel from them was mated back to these hens, and observation in my own and other yards shows that there is no evidence of physical deterioration in either pullets or cockerels of this second generation. Instances of this sort could be multiplied were it necessary.

ONE ADVERSE CASE

It may be asked, have there been any failures as breeders amongst these high competitive producers? I have only met with one case that appeared to point in that direction. This was in connection with a pen of Chinese Langshans which won the fifth annual competition and the first two-years' test, and whose score of 1,481 eggs stood as the record for eight years in these competitions. The hatching and rearing results from these hens in the hands of the purchaser of the pen were certainly disappointing, but their owner assured me that the fault was his. He was at that time quite a novice, and, in his own words, "the hens never had a chance." He has since maintained that same line of blood direct from these hens with results that have given him complete satisfaction.

The available evidence warrants the conclusion that a hen is not to be regarded as a doubtful transmitter of stamina to her progeny because she is the proved possessor of the factor of fecundity in a high or exceptional degree. There is certainly a field for investigational work in the closer study of prepotency in regard to these hens of extreme fecundity, and possibilities for extending the educational side of the competitions in this direction, in co-operation with the owners, might well be a matter for consideration by the controlling authorities. But, as already indicated, the following up, as it were, of the hens after they have been tested at Hawkesbury College, has shown how theoretical and fallacious is the contention that great laying makes great inroads upon the stamina of a hen, and that for this reason, in order to maintain constitutional vigor in the stock, preference should be given to the medium layer in selecting breeding birds. This term "medium" layer is a very vague one. We see some old world self-styled experts advocating the 150-egg hen as the ideal embodiment of constitution required to fulfil the functions of mother of the flock, while others go so far as to pronounce the 180-egg hen a safe proposition. In this country, since the competitions have focussed attention upon all these practical questions, the 200-egg hen has become so commonplace that any possessor of a good laying strain would

ridicule the idea that the hen that has the stamina to sustain laying at the 200-egg rate is constitutionally unfit to efficiently perform her reproductive functions. Logically the same reasoning applies to the 250-egg hen, which is no more a *rara avis* nowadays than was the 200-egg hen in the early years of these competitions. And why stop at the 250-egg layer? Why, indeed, since the actual breeding results show that the danger of decadence does not lie even in the 288-egg hen. Rather is there more reason to argue from the opposite standpoint, that sustained heavy laying is proof of a correspondingly high standard of constitutional soundness.

LOW DEATH RATE

In the second and third year competitions we have had opportunities of observing how the heavy producers of the first year have carried through their second and third seasons. The facts are plain and convincing that there has been no abnormal "cracking up" consequent upon high first-year production. On the contrary, the percentage of deaths is below the average among such hens. For instance, if we analyse the three-years' competition figures and take the ten pens that made the best scores in the first year (all over 1,300 eggs), we find that the percentage of deaths from all causes in the subsequent two years was 11.6, while if we take the ten pens with the lowest first-year records it is seen that the two following years gave 16.6% of deaths. The hens that have broken down constitutionally after exceptional laying in the first year have been few and far between.

Warnings have been sounded that continual breeding for higher egg returns would inevitably produce ovarian disorders and weakness, but it can be definitely stated that the competitions of the past few years supply no evidence whatever of any such signs of an increase in constitutional deterioration. This is not to say that hens do not break down under the strain of heavy laying; but their first year will almost invariably find out their weakness in this respect. It is only in accord with scientific expectation that hens which have maintained uniformly high laying throughout the first-year competition stage, have sustained their vitality, moulted well, and have entered their second season in vigorous condition, fit to fulfil all the requirements of the breeder. This of itself is a strong argument in favour of breeding from second-year or older hens that have proved their vitality and productive capacity.

POINTS FOR SELECTION

The object of this paper is not only to oppose a misleading line of reasoning, but to impress upon breeders one of the obvious guiding lessons of these competitions. This is that the hen of high fecundity is not only a safe, but an eminently desirable unit in the breeding-pen, provided other rational and practical considerations in selection and mating are observed. It is not enough that the breeding hen should be a good layer or the descendant of a line of high producers; physique is essential. Therefore, first regard must be paid to the outward and physical signs of vigor and constitution, and to reasonable conformity to the standard size and type of the breed. The doctrine that selection of vigorous and well-developed birds is the first principle in breeding has been preached since the earliest days of which literature has record of poultry culture. There is no rule more widely known and less practiced. On the majority of farms there are to be seen weedy, narrow-chested specimens with no depth of body and little pretension to type included in the breeding pens, simply on account of their ancestry, or because they are so-and-so's strain, or that they have some supposed external mark of the layer. It is all too common, too, to see pullets of this class being tested out in their first year, with a view to being used later as breeders—pullets which, no matter what their trial performance, could never be worth a place in a well-balanced pen of breeders.

It is impossible to keep up the stamina and quality of the flock, much less improve it, while these primary rules of breeding are apathetically ignored, and until there is a more general observance of these esentials there can not be any general improvement in these characters in the flocks of the great body of commercial or utility poultry-keepers. The study of the individual hens in conjunction with their performances in the single-pen tests of the last three years at Hawkesbury College has furnished invaluable lessons in the correlation of type, physique, and fecundity, and no poultry-farmer should neglect to take the fullest advantage of the opportunity for observation provided by the 420 hens which are being tested in single pens this year. The living object-lessons will be there with the record of the laying of each as the key. It constitutes an educational demonstration capable of practical application in their business as poultry-farmers, such as is not at the disposal of breeders in any other part of the world.

Prussia Subsidizes School Teachers with Children

According to the *Pädagogische Zeitung* the Prussian government, by a decree of October 20, 1915, has made tax concessions, based on the number of their children, to the teachers in public schools. The premium goes as high as 2,100 marks ($525), in which the dwelling or allowance for dwelling is not included. For the first and second child under 15 years, 6 marks; for each additional child 3 marks a month are allowed. These sums will be paid from the national treasury, the local authorities (*Gemeinden*) not being called on for any contribution; so that the latter will be able in this way to stop discriminating against teachers with large families. It is to be hoped that this subsidy will be continued and, if possible, increased after the war, especially for the third and fourth child, so that it will be financially possible for the teachers to abandon the two-child system which has become so widespread among them. As the teachers certainly represent a physical and mental selection from the race, a step in the direction of national eugenics would thus be taken.—Fritz Lenz in *Archiv für Rassen- und Gesellschafts-Biologie*, XI, p. 560. (Published in Munich, Germany.)

Increased Activity in German Eugenics

German plans for counteracting the cacogenic results of the war have several times been mentioned in this Journal. We are now informed of the organization of a *Bund zur Erhaltung und Mehrung der deutschen Volkskraft* with the object of "safeguarding the soundness of present and future generations." It was organized at Halle a. S. with about 1,000 members, and has sent out a number of leaflets to the military forces, on such subjects as alcoholism, venereal diseases, and the need for a high birth-rate. In Berlin a *Deutsche Gesellschaft für Bevölkerungspolitik* has been organized under the initiative of Geh. Regierungsrat Prof. Dr. Julius Wolf, with similar objects. Its program includes prevention of infant mortality, education in mothercraft, rural colonization, and similar indirect methods, as well as more direct propaganda. It announces that it will have nothing to do with "lukewarm researches and half-measures." Its leading spirit appears to be Dr. Albert Moll, a biologist internationally known.

AN APOLOGY FOR YAWNING

YAWNING is commonly said to be a means of ventilating the lungs when they need it. Everyone knows that it is an involuntary act, and often excited by seeing some one else yawn; the real purpose of the act, however, has been very little studied. Prof. F. H. Pike, of the College of Physicians and Surgeons, Columbia University, New York, was asked for his opinion in regard to the evolutionary origin of yawning, and has sent the following remarks, with a warning that they are partly fact and partly hypothesis.

"Luciani in his *Human Physiology*, vol. 1, p. 438, speaks of a deep inspiration as a part of the general process of yawning. He regards it as the external expression of ennui, drowsiness, hunger, and the like, but it does not seem to me that the ventilation of the thorax is the primary object of yawning. On our present views of the nature of the stimulus to respiration, the ventilation of the thorax keeps pace with the changing hydrogen ion content of the blood. An increase in the concentration of the hydrogen ions is accompanied by an immediate increase in the depth or rate of the respiratory movements. There is normally a deeper inspiration than usual occurring every few breaths, and it does not seem probable that there is a sufficient accumulation of carbon dioxide in the blood under any ordinary conditions to require any extreme effort such as yawning would indicate if its main purpose were to ventilate the lungs. A little vigorous exercise will remove the immediate cause of yawning, but it will also result in a greater ventilation of the thorax and lungs than occurred during yawning.

MUSCULAR MOVEMENTS

"Yawning, in a state of nature, involves certain attendant movements and sounds that are absent in the human subject, after a course in a young ladies' finishing school or any similar institution. The dog gives a sort of whine and stretches his other muscles, particularly those of the fore legs, as well as those of the head and jaws. I am more and more inclined to regard yawning as an expression of a state of approaching fatigue, very much analogous to the other stretching movements of muscles in general. It may be a sort of involuntary exercise to keep one awake until a safe place for sleeping may be found. There is always a little quickening of the faculties after a deep yawn, and this is more pronounced if there is an attendant stretching of the muscles. One might imagine that the impulse to sleep might begin to come upon an animal while still out in the open, and that, if no warning sign were present, he might lie down in the open and go to sleep in a place exposed to attack from enemies. The continued yawning may be sufficient to keep him awake until he can reach a place of safety. This particular kind of utility may be lacking in civilized man, but the whole mechanism persists unchanged. To a certain limited extent, yawning might be regarded as a vestigal function if regarded from this point of view alone. But I am not sure that yawning has ceased to be useful to civilized man. The onset of yawning may interrupt a process which might otherwise be carried to a harmful degree. A student begins to yawn in the evening, and, unless he resorts to some measures to overcome his drowsiness, the interruption to his work is likely to become so great that he seeks relief in sleep. If he employ measures to drive away his drowsiness, such as the use of strong coffee, a walk around the block, or other similar things, he may be able to go on working, but he is pretty certain later on to feel, more severely than ever, the effects of fatigue, and he may suffer great injury if he persists too long in disregarding these warning signs of nature.

A WARNING FROM NATURE

Yawning is commonly said to be a means of ventilating the lungs, but ventilation appears really to be a very small part of the act. It seems more likely that it is a warning of drowsiness and need of sleep. On this hypothesis it could easily be shown to be useful in natural selection. Suppose an animal traveling in the open is suddenly overcome with fatigue and the need of sleep: if he went to sleep on the spot he would be exposed to enemies and perhaps perish. The yawn warns him to look for shelter and rest, and there seems to be a slight quickening of the faculties after yawning which aids the animal to get to a place of safety. The act may still be of use to man in a similar connection, warning him when he has worked long enough and needs to seek repose. This explanation is hypothetical, as the subject has been little studied; but yawning appears at any rate to be a very primitive function, going back far beyond the mammals in the scale of evolution. Photograph from the Nursery Studio, Washington, D. C. (Fig. 5.)

"I think Luciani is right in regarding yawning as an expression of drowsiness, but I believe also that too much emphasis has been placed on the factor of ventilation of the lungs. As a matter of fact, if one yawns widely, there is a total cessation of the movements of the thorax and diaphragm during the period when the mouth is most widely open. This I attribute to the stimulation of the endings of the glossopharyngeal nerve in the pharynx and uvula by the stretching of these portions of the alimentary tract at that time. It is well known that stimulation of the glosso-pharyngeal nerve will stop all respiratory movements immediately. Such a cessation normally occurs during swallowing. At the moment anything touches the uvula, respiration ceases immediately. One can feel the stretching of the pillars of the fauces and of the pharynx and uvula, or, more correctly, the part of the soft palate immediately to each side of the uvula, when the mouth is widely open in yawning."

Not only is yawning a very primitive adaption (if, indeed, it be an adaptation) but it appears to go back to a remote stage of evolution, perhaps far below the age of mammals. On this point Dr. Pike remarks:

"In thinking over the matter superficially it appears that the primitive respiratory neuro-muscular mechanism is the part particularly concerned. In fishes, the respiratory system involves the musculature of the mouth and possibly of the pharynx, and the nerves concerned are the fifth, seventh, ninth, tenth and twelfth cranial. The diaphragm and the phrenic nerve have not yet made their appearance, and the intercostal nerves and muscles are not concerned in the respiratory movements. That is what I mean by the primitive neuro-muscular respiratory mechanism. The muscles of the face and pharynx are involved in yawning, and the fifth, ninth, tenth and twelfth cranial nerves are also involved. I do not know where in the animal scale yawning first appears, but I should imagine that we might expect it in all the mammals, and possibly in some of the poikilothermal forms. It seems to be present in birds. In some respects, it approaches the type of respiration that is seen in cases of approaching death. In such circumstances, we have again the participation of the primitive neuro-muscular respiratory mechanism. The mouth is opened widely, often with a quivering or unsteady movement, and the thorax does not participate to the same extent as in normal respiration. The movements of the thorax may persist, altered in rhythm, to be sure, but nevertheless present, during yawning. I think that this is further evidence of the fact that yawning is related to the primitive mechanism."

Why Do Women Become Mothers?

"The facts, shorn of sentiment," says Mrs. Leta S. Hollingworth in the July *Am. Journ. Sociology*, "are: (1) The bearing and rearing of children is necessary for tribal or national existence and aggrandizement. (2) The bearing and rearing of children is painful, dangerous to life, and involves long years of exacting labor and self-sacrifice. (3) There is no verifiable evidence to show that a maternal instinct exists in women of such all-consuming strength and fervor as to impel them voluntarily to seek the pain, danger and exacting labor involved in a high birth-rate." The pressure of insidious forces set at work by certain "radiant centers of social control" has made women bear children in the past, she thinks, but she considers that her sisters are now on the eve of being emancipated, and that henceforth they will bear few children, unless they get "adequate compensation, either in money or in fame."

RELIGION AND BIRTH CONTROL

ANTAGONISM of the Roman Catholic church toward the "birth control" movement is well known. This antagonism is based on theological grounds, but it has frequently been pointed out that the result, whether the church has the fact in mind or not, will be to give the church a slowly increasing preponderance in numbers, in any community where the population is made up in part of Catholics and in part of Protestants.

The Church of Latter-Day Saints of Jesus Christ, popularly known as the Mormon church, has taken a similarly antagonistic stand on birth control. Theological objections are raised against it; but in this case what may be called the eugenic aspect, the problem of altering the relative proportions of different classes in a population, is clearly seen and acknowledged.

In the July issue of the *Relief Society Magazine*, an official publication issued at Salt Lake City, five of the twelve elders who make up the supreme council of the organization state their views on birth control. Elder Rudger Clawson says that it is sinful to restrict the number of children in a family, continuing:

"Woman is so constituted that, ordinarily, she is capable of bearing, during the years of her greatest strength and physical vigor, from eight to ten children, and in exceptional cases a larger number than that. The law of her nature so ordered it, and God's command, while it did not specify the exact number of children allotted to woman, simply implied that she should exercise the sacred power of procreation to its utmost limit."

Elder George F. Richards writes: "My wife has borne to me fifteen children. Anything short of this would have been less than her duty and privilege."

The eugenic view of the subject is most clearly seen by elder Joseph F. Smith, Jr., who points out:

"The first great commandment given both to man and beast by the Creator was to be fruitful and multiply and replenish the earth; and I have not learned that this commandment was ever repealed. Those who attempt to pervert the ways of the Lord, and to prevent their offspring from coming into the world in obedience to this great command, are guilty of one of the most heinous crimes in the category. There is no promise of eternal salvation and exaltation for such as they, for by their acts they prove their unworthiness for exaltation and unfitness for a kingdom where the crowning glory is the continuation of the family union and eternal increase which have been promised to all those who obey the law of the Lord. It is just as much murder to destroy life before as it is after birth, although man-made laws may not so consider it; but there is One who does take notice and his justice and judgment is sure.

"I feel only the greatest contempt for those who, because of a little worldly learning or a feeling of their own superiority over others, advocate and endeavor to control the so-called 'lower classes' from what they are pleased to call 'indiscriminate breeding.'

"The old Colonial stock that one or two centuries ago laid the foundation of our great nation, is rapidly being replaced by another people, due to the practice of this erroneous doctrine of 'small families.' According to statistics gathered by a leading magazine published in New York, a year or two ago, the average number of children to a family among the descendants of the old American stock in the New England States, was only two and a fraction, while among the immigrants from European shores who are now coming into our land, the average family was composed of more than six.

"Thus the old stock is surely being replaced by the 'lower classes' of a sturdier and more worthy race. Worthier because they have not learned, in these modern times, to disregard the

great commandment given to man by our Heavenly Father. It is indeed, a case of the survival of the fittest, and it is only a matter of time before those who so strongly advocate and practice this pernicious doctrine of 'birth control' and the limiting of the number of children in the family, will have legislated themselves and their kind out of this mortal existence."

It is proper to point out that birth control is not, as the public seems to suppose, an integral part of the eugenics propaganda. Many eugenicists advocate it; many others oppose it. In either case, it must be regarded as a fact with which eugenics must deal. If one section of a community limits the number of births, and another section does not, it is easy to calculate how soon the latter section will supplant the former, and there are plenty of object lessons such as Mr. Smith cites, in the old colonial stock of New England

A RELATIVE MATTER

The eugenicist, of course, is more interested in the quality than in the quantity of the population. The quantity is important only in a *relative* way. In opposition to Mr. Smith and other people without adequate knowledge of biology, the eugenicist holds that there is a difference in the inherent quality of various sections of the population, and that if an inferior section multiplies much more rapidly than a superior section, the result will be very serious from the standpoint of national efficiency and racial progress.

Precisely such a result has taken place in the United States during the past half-century.

It is unquestionable that the number of births has been much limited in the economically most efficient sections of the population of the United States, and very little limited in the least efficient sections.

It is also unquestionable that the spread of the birth control propaganda in the "lower classes" is at the present time very rapid. Whether or not one approves of that spread, it is certain that the birth-rate in those classes is likely to fall, thus checking the very serious *differential* nature of the present birth-rate.

If, at the same time, eugenics can succeed to some extent in increasing the birth rate among the socially most valuable sections of the community, then the present demonstrable deterioration of the American stock, as a whole, will gradually become less menacing.

Some New Water-Lilies

Most of the water-lilies commonly grown in gardens are chance hybrids. The Missouri Botanical Garden has started systematic breeding work with them, on the one hand to purify some of the strains and on the other hand to produce more desirable hybrid combinations. One Nymphaea has already been produced by four generations of inbreeding which bears only pink flowers, the blue having been eliminated altogether. A hybrid of a night-blooming and day-blooming species has been secured which has the advantage of remaining open longer than ordinary day-flowering species. It is stated that water-lilies are easily crossed, and many amateurs might work with them.

Yak Increasing in Canada

In 1909 the Duke of Bedford gave six yaks to the Canadian government. They are now at Banff, Alberta, and have increased to fourteen. The Canadians hope to make them useful as the foundation of a breed of hardy cattle for the north, just as the American Government is planning in Alaska. The latter experiment was described in the JOURNAL OF HEREDITY for January, 1916 (Vol. VII, p. 48), where an illustration was published.

FORGOTTEN BUD VARIATIONS

Early Orange Growers Found Many "Sports" but did not Recognize Their Significance—Origin of New Varieties—Great Care Needed in Propagation to Get only the Most Desirable Variations

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THE work which A. D. Shamel, of the Office of Horticultural and Pomological Investigations of the U. S. Department of Agriculture, has done in demonstrating the variations existing within standard citrus varieties has awakened practical citrus growers at least to a realization of the great individual tree differences in their own plantings and also to the surprising frequency with which bud sports occur in standard citrus varieties.

The investigational work and observations made by members of the staff in California, Florida, the Gulf States, Brazil and Cuba have shown that all citrus varieties in every section have this tendency to break up into a number of different strains. These strains are found occurring as whole trees, as limb sports and as individual fruit sports. It is most interesting in this connection to note that some of the old citrus pioneers of thirty years ago observed striking instances of bud variations, but unfortunately were unable to correlate the observations which they made or to realize that they had within their grasp a principle which has since been demonstrated by Mr. Shamel to be of vital importance to all citrus growers.

Even a casual perusal of the old files of the Office of Horticultural and Pomological Investigations will show that the old horticulturists, both in Florida and California, were attempting to explain the variations which they observed. As a rule, a sporting fruit was generally explained as having been caused by cross-fertilization. An example of such an explanation is contained in the following extract of a letter from E. H. Hart, Federal Point, Fla., February 10, 1887, addressed to Prof. H. E. Van Deman, Pomologist of the United States Department of Agriculture:

"I send you today as per enclosed shipping receipt a box of oranges setting forth the contrasts between their normal condition and after having been subjected to fertilization with pollen from the Navel orange. These ought to prove conclusively the effect of hybridizing upon the fruit as well as the seed. You will observe not only striking modifications in shape but also in the flavor. The varieties most clearly resembling the Navel in habit of growth and outlines of fruit are much more readily affected except perhaps in the case of *Citrus nobilis*, which although the very antipodes of the Navel structurally as well as geographically, nevertheless mixes with it more often than any. It is somewhat singular too that propinquity does not always favor the mixture as trees at a little distance are more often affected than when both kinds have been grafted onto one stock."

The tendency of all citrus varieties to throw Navel sports is very pronounced; the fact that Mr. Hart observed this in 1887 is interesting although his explanation of the cause was wrong.

On March 12, 1887, J. E. Cutter, a prominent citrus grower and nurseryman, of Riverside, Cal., sent in to the Department at Washington a number of samples of orange varieties. Included in the list were two distinct lots of

A NAVEL GRAPEFRUIT

This variable fruit (photographed actual size) shows two great deviations from the original condition of the grapefruit. In the first place, it has lost its seeds; in the second place it has taken on a navel, just like that of the navel orange. In the case of the grapefruit, the navel is scarcely visible from the outside. This fruit is of no particular value commercially, but serves graphically to illustrate the fact that extreme bud variations or "sports" are constantly taking place in the citrus fruits, and probably in all other cultivated fruits. It is highly necessary that horticulturists keep on the lookout for such variations, and that they propagate from the desirable, not the undesirable ones. The orange industry of California is now being almost made over, in some sections, by attention to this principle. (Fig. 6.)

Paper Rind St. Michael fruits borne on two separate trees. One of these lots Mr. Cutter designated as the normal Paper Rind St. Michael and the other as "Reverted Types." In commenting on the "Reverted types" he said:

"The 'Reverted Types' of the St. Michael are from a tree which is bearing at the time the usual type of the same. A comparison of these 'Reverted Types' with the usual and with common oranges shows that the St. Michael, . . . so highly prized for its splendid quality, juiciness and solidity . . . is itself a sport. Specimens are occasionally found which are half 'Paper Rind' and half 'Reverted.'"

On April 21, 1887, in reply to a request for further information concerning the St. Michael variations he wrote as follows:

PAPER RIND VALENCIAS

"In my former letter I used the term 'reverted type' [of St. Michael oranges] to indicate an orange that has *sported back* to the normal form, appearance and quality. These 'reverted types' grew on the same trees and among the usual kind of 'paper rind' St. Michaels.

STRIKING VALENCIA VARIATIONS

At the left is shown the Standard Valencia orange, a California variety which has almost a monopoly of the eastern markets in the summer. At the right is a bud sport of the Valencia, to which the name of Paper Rind has been given. Evidence from orange growers of the last generation indicates that this particular bud sport has often occurred. This particular Valencia strain appears to be identical with the true Paper Rind St. Michael which originated as a bud variation of the St. Michael. Photograph slightly reduced. (Fig. 7.)

I therefore regard them as proof that the 'paper rind' St. Michael is a *sport*. You will remember that the 'reverted types' were of the thicker skin, deeper color, and looser texture of common fruit while the 'paper rind' is the thinnest of skin, pale and exceedingly compact and firm textured."

Mr. Cutter's observations as to the origin of the Paper Rind St. Michael are all the more interesting in view of the fact that in the course of the fruit improvement investigations which Mr. Shamel is conducting in California, a smooth, thin skin strain of Valencia orange has been found which apparently is identical with the Paper Rind St. Michael. The finding of this strain of Valencia, and the fact that Mr. Cutter in 1887 observed a St. Michael tree the fruits of which reverted back to a larger coarser strain would seem to be almost conclusive proof that the Paper Rind St. Michael variety originated as a bud sport or bud variation. How valuable it would be if we could secure authentic information concerning all our fruit varieties. No doubt if we could get at the truth concerning the origin of our fruit varieties we would find that many varieties of supposedly "chance seedling" origin had in reality originated as bud variations.

Mr. Cutter sent samples of the sporting fruits to a number of people in Florida and E. H. Hart, of Federal Point, Fla., previously referred to, in a letter on May 21, 1887, to Prof. H. E. Van Deman made the following comment:

"Yours of the eighteenth together with Mr. Cutter's letter and the specimens of oranges were received today. Fruits like these are occasionally seen upon our orange trees and in general I have attributed their peculiariities to cross-fertilization but in a strongly marked case like that tree of Mr. Cutter's, it must be owing either to the influences upon the condition of the tree of the injuries formerly received, or it may be an instance of bud variation. The reverting tendency may have existed in the particular bud used in working over the tree. I have an old bearing tree which has always produced

these varying types of oranges very abundantly and although I have not given much thought to the subject, yet the bud-variation theory seemed the easiest way of explaining the difficulty."

After discussing some other subjects he gives an instance of bud variation which has come under his own observation.

"The orange known here as Duroi is frequently marked with ribbed segments differing in exterior from the remainder of the affected specimen which would suggest the permanency of the reversion theory in that particular variety."

MANY VARIATIONS

Other instances of bud variations were mentioned by Mr. Hart in a letter of May 9, 1888, to Prof. Van Deman:

"I would remark here that the normal shape of Hart's Late is oblong—often to a marked degree—but growing as they do all about among other kinds, the shape is modified by admixtures. I notice the same in the case of Early Oblong, which are often so changed in form as to be hardly recognizable."

A very careful student and a recognized authority on pomological matters in Florida at this time was the Rev. Lyman Phelps, of Sanford, Fla. In a letter from him under date of May 6, 1887, to Prof. Van Deman he makes the following observations concerning bud variations:

"I send you three oranges this morning by mail, two flat ones—they are a sport of some kind from an Italian orange, not from seed but from bud. I have perhaps a hundred trees budded from a tree imported by Gen. H. S. Sanford and this particular tree has borne this shaped orange continually. It is more solid than any of the fruit on the other trees and most of the specimens show umbilical marks."

John Carville Stovin, of Winter Park, Fla., in a letter written May 20, 1887, to Prof. Van Deman, states:

"The best Italian orange grown at Belair and imported by Mr. Sanford has sported into a Navel in one tree on my place."

These few instances have been chosen from many which might be given for the reason that the observations were made by men prominently identified with the fruit industry of their day. These observations simply add their support to the rapidly accumulating mass of evidence, going to show that variations have existed within standard fruit varieties in greater numbers than anyone has dreamed were possible, and also that great care has to be used in selecting budwood in order that the chance of propagating undesirable variations may be eliminated.

Improving the Wheat of Sweden

The introduction of several new varieties of wheat is reported by H. Nilsson-Ehle in the Sveriges Utsädesförenings Tidskrift, summarized in the *International Review of Agriculture*. The latest productions of the Svalöf station are named Pansar and Fylgia; their yields are respectively 140 and 135 if the native Swedish wheat is taken at 100. The work of the Svalöf station, which offers one of the most conspicuous successes in both the theory and practice of plant-breeding, was described by its director in the JOURNAL OF HEREDITY for July, 1914 (Vol. V, No. 7).

Annual Meeting of the A. G. A.

The annual meeting of the American Genetic Association will be held in New York City, December 26–31, in connection with the American Association for the Advancement of Science. Members who wish to contribute papers to the program should communicate with the secretary as soon as possible.

HEREDITY AND THE MIND

Many Kinds of Logical Evidence that Mental Traits Are Inherited in the Same Way and to the Same Extent as Physical Characters—Educators Must Deal with This Fact, and not Be Misled by Dogmas of Speculative Psychology

THE EDITOR

IT IS the fashion nowadays, among some psychologists and educators, to attack the inheritance of mental traits. Of course, it is granted that some sort of a groundwork must be transmitted, but we are asked by the extremists to believe that this is little more than a clean slate on which the environment, particularly during the early years of life, writes its autograph.

"What is often called heredity," we are told,[1] "is merely the expression of the subconscious ego, whose origin can often be traced back to early childhood, to the time when the acts of their parents and their example left their impress in the unconscious."

"Idiosyncrasies of action, peculiarities, sympathies, likes and dislikes, prejudices, preformed judgments, aggressiveness, passivity, marked artistic ability and tendencies, temperament, these and many more traits," we are informed,[2] "have been explained on the basis of acquired complexes. And as far as the evidence and explanations are concerned, they both seem quite valid."

"Every child," we are assured,[3] "at the outset of his life is a little impulsive being, pushed indifferently toward good or evil according to the influences which surround him."

Such criticisms are a useful stimulus, but they must be given no more weight than they deserve.

If it were true that heredity can deal only with the physical, and not with the mental, then eugenics would have little excuse for existence; for its primary object is to increase the amount of ability in the race, and it depends for success on the belief that differences in ability are due to differences in heredity.

But is it true? Has genetics no valid evidence that mental traits are inherited?

PROGRESS IN ANALYSIS IS SLOW

It must be admitted that the analysis of the inheritance of mental traits is proceeding slowly. This is not the fault of the geneticist, but rather of the psychologist, who has not yet been able to furnish the geneticist with the description of definite traits of such a character as to make possible the exhaustive analysis of their individual inheritance. That department of psychology is only now being formed.

We might even admit that no inherited "unit character" in the mind has yet been isolated; but it would be a great mistake to assume from this admission that proof of the inheritance of mental qualities, in general, is lacking.

The psychologists and educators who think so appear either to be swayed by the necessity of supporting dogmatic or metaphysical views of the mind, or else they think that resemblance between parent and offspring is the only evidence of inheritance that we can offer. The father dislikes cheese; the son dislikes cheese. "Aha, you think that is the inheritance of a dislike for cheese," cries the psychologist, "but we will

[1] Waldstein, L. Das unterbewusste Ich und sein Verhaltnis zu Gesundheit und Erziehung. Grenzfr. des Nerven u. Seelenlehre, Band 9 (1908), Heft 62, p. 8. Quoted by Kohs, *infra*.

[2] Kohs, S. C. New Light on Eugenics. JOURNAL OF HEREDITY, Vol. VII (1915), p. 450.

[3] Bruce, H. Addington, in *The Century Magazine*. The phrase is borrowed from Pascal, a fact which gives an idea of Bruce's psychological orientation.

teach you better." An interesting example of this sort of teaching is furnished by Dr. Boris Sidis, lately professor of psychology at Harvard, whose feelings are outraged because geneticists have represented that some forms of insanity are hereditary. He declaims for several pages[4] in this fashion.

> "The so-called scientific method of the eugenists is radically faulty, in spite of the rich display of colored plates, stained tables, glittering biological speculations, brilliant mathematical formulae and complicated statistical calculations. The eugenists pile Ossa on Pelion of facts by the simple method of enumeration which Bacon and the thinkers coming after him have long ago condemned as puerile and futile. From the savage's belief in sympathetic, imitative magic with its consequent superstitions, omens, and taboos down to the articles of faith and dogmas of the eugenists we find the same faulty, primitive thought, guided by the puerile, imbecile method of simple enumeration, and controlled by the wisdom of the logical *post hoc, ergo propter hoc*."

Now if resemblance between parent and offspring were, as Sidis supposes, the only evidence of inheritance of mental traits which the geneticist can produce, his case would indeed be weak. And it is perfectly true that "evidence" of this kind has sometimes been advanced by geneticists who should have known better.

But this is not the real evidence which genetics offers. The evidence is of numerous kinds, and several lines might be destroyed without impairing the validity of the remainder. It is impossible to review the whole body of evidence here, but some of the various kinds may be indicated, and samples given. The reader will then be able to form his own opinion as to whether the geneticists' proofs or the mere assurances of a few psychologists like Sidis are the more weighty.

1. The analogy from breeding experiments. Tame rats, for instance, exhibit about as much life as a bag of meal; their offspring can be handled without a bit of trouble. The wild rat, on the other hand, is always ready to fight at the drop of the hat.

Prof. W. E. Castle, of Harvard University, writes:[5] "We have repeatedly mated tame female rats with wild males, the mothers being removed to isolated cages before the birth of the young. These young which had never seen or been near their father were very wild in disposition in every case. The observations of Yerkes on such rats raised by us indicates that their wildness was not quite as extreme as that of the pure wild rat but closely approached it."

Who can suggest any plausible explanation of their conduct, save that they inherited a certain temperament from their sire? Yet the inheritance of temperament is one of the things which the psychologists most "view with alarm." If it is proved in other animals, can we accept the psychologists' declaration that it is wholly impossible in man?

EVIDENCE FROM SEGREGATION

2. The segregation of mental traits. When an insane, or epileptic, or feebleminded person mates with a normal individual, in whose family no taint is found, the offspring (generally speaking) will all be mentally sound, even though one parent is affected. On the other hand, if two people from tainted stocks marry, although neither one may

[4] Sidis, Boris, M.A., Ph.D., M.D. Neurosis and Eugenics. *Medical Review of Reviews*, Vol. XXI, No. 10, pp. 587–594, New York, October, 1915. Dr. Sidis' article may be good medicine for the patients of the Sidis Psychotherapeutic Institute, Portsmouth, N. H., but it is not good science. How little he knows of elementary biology is revealed by an allusion (p. 591) to "some miraculous germ-plasm (chromatin) with wonderful dominant 'units' (chromosomes)." A college freshman in biology would be ashamed to think that chromosomes and hereditary unit characters are the same thing. A distinguished psychologist who does not know the difference, and who writes of "dominant chromosomes," is hardly a competent critic of the facts of heredity.

[5] Dr. Sewall Wright called my attention to this critical evidence, and Dr. Castle furnished the details, in a letter dated August 4, 1916. He adds, "I am not satisfied that a clear statement can be made at the present time as to the inheritance in later generations. But my impression is, from handling large numbers of second generation rats, that there is little evidence of segregation and I am inclined to think that the inheritance is blending. As to the principal question which you raise whether temperament is inherited or not there is no doubt. The only question arises as to the precise manner of its inheritance."

be personally defective, part of their offspring will be affected.

This production of sound children from an unsound parent, in the first case, and unsound children from two apparently sound parents in the second case, is exactly the opposite of what we should expect if the child gets his unsoundness merely by imitation or "contagion." The difference cannot reasonably be explained by any difference in environment or external stimuli. Heredity offers a satisfactory explanation, for some forms of feeblemindedness and epilepsy, and some of the diseases known as insanity behave as recessives and segregate in just the way mentioned. We can show abundant analogies in the inheritance of other traits in man, lower animals, and plants, that behave in exactly the same manner.

So far as I am aware, no psychologist has yet come forward to "demonstrate" that feeblemindedness is due to a subconscious complex formed in childhood, instead of to heredity, but some of them appear to be moving in that direction. No one would allege that all mental defect is due to inheritance; perhaps only a small part is, although all data now available indicate that the part is a majority. But there are many cases in which the heredity factor can hardly be denied without stultification; and if mental defects are inherited, then it is worth while investigating whether mental excellences may not be.

EVIDENCE FROM TWINS

3. The persistence of like qualities regardless of difference in environment. Any parent with open eyes must see this in his own children—must see that they retained the inherited traits even when living under entirely different surroundings. But the histories of twins furnish the most graphic evidence. Galton, who collected detailed histories of thirty-five pairs of twins who were closely alike at birth, and examined their history in after years, writes,[6] "In some cases the resemblance of body and mind had continued unaltered up to old age, notwithstanding very different conditions of life," in other cases where some dissimilarity developed, it could be traced to the influence of an illness. Making due allowance for the influence of illness, yet "instances do exist of an apparently thorough similarity of nature, in which such difference of external circumstances as may be consistent with the ordinary conditions of the same social rank and country do not create dissimilarity. Positive evidence, such as this, cannot be outweighed by any amount of negative evidence."

Dr. Frederick Adams Woods has brought forward[7] a piece of more exact evidence under this head. We know by many quantitative studies that, in physical heredity, the influence of the paternal grandparents and the influence of the maternal grandparents is equal; on the average one will contribute no more to the grandchildren than the other. If mental qualities are due rather to early surroundings than to actual inheritance, this equality of grandparental influence is incredible in the royal families where Woods got his material; for the grandchild has been brought up at the court of the paternal grandfather, where he ought to have got all his "acquirements," and has perhaps never even seen his maternal grandparents, who therefore could not be expected to impress their mental peculiarities on him by "contagion." When Woods actually measured the extent of resemblance to the two sets of grandparents, for mental and moral qualities, he found it to be the same in each case: as is inevitable if they are inherited, but as is incomprehensible if heredity is not responsible for one's mental makeup.

ENVIRONMENT IS POWERLESS

4. Persistence of unlike qualities regardless of sameness in the environment. This is the converse of the preceding proposition, but even more convincing. Here again, I quote Galton,[8] with a

[6] Galton, Francis. Inquiries into Human Faculty, p. 167. London, 1907.
[7] Woods, Frederick Adams. Heredity in Royalty. New York, 1906.
[8] *Op. cit.*, pp. 170–171.

preliminary remark about the nature of twins.

There appear to be two ways in which twins are ordinarily produced. They may be the result of the simultaneous fertilization of two egg-cells, in which case they are no different from ordinary brothers, or sisters, except that they happen to be born simultaneously. On the other hand, they may be produced by a division of a single egg-cell, at an early stage in development; in such cases they are always of the same sex, and very closely alike, as one would expect from the fact that they are really halves of the same individual.

In the former quotation from Galton, we dealt with the second class, the so-called identical twins, who are very much alike at birth for the good reason that they have identical heredity. We found that this heredity was not modified, either in the body or in the mind, by ordinary differences of training and environment. A few of Galton's histories of ordinary, non-identical twins, follow:

> One parent says: "They have had *exactly the same nurture* from their birth up to the present time; they are both perfectly healthy and strong, yet they are otherwise as dissimilar as two boys could be, physically, mentally, and in their emotional nature."
>
> Another writes: "I can answer most decidedly that the twins have been perfectly dissimilar in character, habits and likeness from the moment of their birth to the present time, although they were nursed by the same woman, went to school together, and were never separated until the age of 15."
>
> "Very dissimilar in body and mind," is the description of another parent. "The one is quiet, retiring, and slow but sure; good tempered, but disposed to be sulky when provoked—the other is quick, vivacious, forward, acquiring easily and forgetting soon; quick-tempered and choleric but easily forgetting and forgiving. They have been educated together and never separated."
>
> Again, "The two sisters are very different in ability and disposition. The one is retiring, but firm and determined; she has no taste for music or drawing. The other is of an active, excitable temperament: she displays an unusual amount of quickness and talent, and is passionately fond of music and drawing. From infancy, they have rarely been separated even at school, and as children visiting their friends, they always were together."

If, in the face of such examples, the psychologist can maintain that differences in mental make-up are due to different influences during childhood, and not to differences in heredity, he certainly has a colossal faith in his theories. We are not obliged to depend, under this head, for mere descriptions, but can supply accurate measurements to demonstrate our point. If the environment creates the mental nature, then ordinary brothers, not more than four or five years apart in age, ought to be about as closely similar to each other as identical twins are to each other; for the family influences in each case are practically the same. Thorndike, by careful mental tests, showed[9] that this is not true. The ordinary brothers come from different egg-cells, and, as we know from studies on lower animals, they do not get exactly the same inheritance from their parents; they show, therefore, considerable differences in their psychic natures. Real identical twins are two halves of the same egg-cell, they halve the same heredity, and their natures are therefore much more nearly identical.

Again, if the mind is molded during the "plastic years of childhood," children ought to become more alike, the longer they are together. Twins who were unlike at birth ought to resemble each other more closely at 14 than they did at 9, since they have been for five additional years subjected to this supposedly potent but very mystical "molding force." Here again Thorndike's exact measurements explode the fallacy. They are actually, measurably, less alike at the older age; their inborn natures are developing along predestined lines, with little regard to the identity

[9] Thorndike, E. L. Measurements of Twins. *Arch. of Philos., Psych., and Sci. Methods*, No. 1, New York, 1905; summarized in his Educational Psychology, Vol. III, pp. 247–251, New York, 1914. Measured on a scale where 1 = identity, he found that twins showed a resemblance to each other of about .75, while ordinary brothers of about the same age resembled each other to the extent of about .50 only. The resemblance was approximately the same in both physical and mental traits.

of their surroundings. Heredity accounts easily for these facts, but they cannot be squared with the idea that mental differences are the products solely of early training.

THE EFFECT OF TRAINING

5. Differential rates of increase in qualities subject to much training. If the mind is formed by training, then brothers ought to be more alike in qualities which have been subject to much training, than they are in qualities which have been subject to little or no training. Thorndike's measurements on this point show the reverse to be true. The likeness of various traits is determined by heredity, and they may be most unlike in traits which have been subjected to a large and equal amount of training. Twins were found to be less alike in their ability at addition and multiplication, in which the schools had been training them for some years, than they were in their ability to mark off the A's on a printed sheet, or to write the opposites to a list of words—feats which they had probably never before tried to do.

This same proposition may be put on a broader basis.[10] "In so far as the differences in achievement found amongst a group of men are due to the differences in the quantity and quality of training which they had had in the function in question, the provision of equal amounts of the same sort of training for all individuals in the group should act to *reduce* the differences." "If the addition of equal amounts of practice does *not* reduce the differences found amongst men, those differences cannot well be explained to any large extent by supposing them to have been due to corresponding differences in amount of previous practice. If, that is, inequalities in achievement are not reduced by equalizing practice, they cannot well have been caused by inequalities in previous practice. If differences in opportunity cause the differences men display, making opportunity more nearly equal for all by adding equal amounts to it in each case should make the differences less.

"The facts found are rather startling. Equalizing practice *seems to increase differences*. The superior man seems to have got his present superiority by his own nature rather than by superior advantages of the past, since, during a period of equal advantages for all, he increases his lead." This point has been tested by such simple devices as mental multiplication, addition, marking A's on a printed sheet of capitals and the like; all the contestants made some gain in efficiency, but those who were superior at the start were proportionately *farther ahead than ever* at the end. This is what the geneticist would expect, but fits very ill with the popular psychology which denies that any child is mentally limited by nature.

MEASURING RESEMBLANCE

6. Direct measurement of the amount of resemblance of mental traits in brothers and sisters shows that it is on the average equal to that of physical traits. It is manifestly impossible to assume that early training, or parental behavior, or anything of the sort, can have influenced very markedly the child's eye color, or the length of his forearm, or the ratio of the length of his head to its breadth. If we measure the amount of resemblance between two brothers in such traits, we may say very confidently that our measurement represents the influence of heredity; that the child inherits his eye color and other physical traits of that kind from his parents. The resemblance, measured on a scale from 0 to 1, has been found to be about 0.5.

Pearson measured the resemblance between brothers and sisters in mental traits—for example temper, conscientiousness, introspection, vivacity—and found it on the average to have just the same intensity—that is, about 0.5. Further measurements of this sort with other traits are needed; but if future investigations confirm Pearson's finding that the resemblance between brothers

[10] The quotations in this and the following paragraph are from Thorndike's Educational Psychology, pp. 304–305, Vol. III.

and sisters for mental traits is the same as it is for physical traits, then we cannot help being struck by the remarkable coincidence.

Or is it a coincidence? We have the measurement of a large number of traits; and as Pearson points out, any mathematician who calculates the chances that it is a mere coincidence, will find the odds so heavily against him that it is hardly conceivable that it is a mere coincidence. Prof. Pearson was obliged to conclude that it shows mental traits are inherited in the same way, and to the same degree as physical traits. This line of reasoning has not proved wholly acceptable to many psychologists; but none has yet been able to offer any other sensible explanation of the supposed coincidence. Prof. Pearson writes:[11]

"It has been suggested that this resemblance in the psychological characters is compounded of two factors, inheritance on the one hand and training and environment on the other. If so, you must admit that inheritance and environment make up the resemblance in the physical characters. Now these two sorts of resemblance being of the same intensity, either the environmental influence is the same in both cases or it is not. If it is the same, we are forced to the conclusion that it is insensible, for it cannot influence eye-color. If it is not the same, than it would be a most marvellous thing that with varying degrees of inheritance, some mysterious force always modifies the extent of home influence, until the resemblance of brothers and sisters is brought sensibly up to the same intensity! Occam's razor[12] will enable us at once to cut off such a theory. We are forced, I think literally forced, to the general conclusion that the physical and psychical characters in man are inherited within broad lines in the same manner, and with the same intensity. The average home environment, the average parental influence is in itself part of the heritage of the stock and not an extraneous and additional factor emphasizing the resemblance between children from the same home."

A paragraph from Schuster[13] may appropriately be added. "After considering the published evidence a word must be said of facts which most people may collect for themselves. They are difficult to record, but are perhaps more convincing than any quantity of statistics. If one knows well several members of a family, one is bound to see in them likenesses with regard to mental traits, both large and small, which may sometimes be accounted for by example on the one hand or unconscious imitation on the other, but are often quite inexplicable on any other theory than heredity. It is difficult to understand how the inheritance of mental capacity can be denied by those whose eyes are open and whose minds are open too."

Broadly speaking, it is of course true that man inherits nothing more than the capacity of making mental acquirements. But this general capacity is made up of many separate capacities, all of these capacities are variable, and the variations are inherited. Such is the unmistakable verdict of the evidence.

It follows, then, that the only sure way to increase the amount of mental ability in the race is by encouraging parents who have ability to produce offspring, and by discouraging parents who lack ability from producing offspring. In this way the level of ability—at least, potential ability—will inevitably rise with each generation.

It follows, too, that attempts made by educators to create ability by education, where the inherited capacity does not exist, are doomed to failure. On the other hand, a scientific system of education which would ascertain what innate capacities the child has, and develop them as far as was desirable would probably produce a surprisingly effective result.

Our conclusions as to the inheritance of all sorts of mental capacity are not

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[11] Biometrika, Vol. III, p. 156.

[12] "William of Occam's Razor" is the canon of logic which declares that it is foolish to seek for several causes of an effect, if a single cause is adequate to account for it.

[13] Schuster, Edgar. Eugenics, pp. 159–160. London, 1913.

based on the mere presence of the same trait in parent and child. They are based on many different kinds of proof of the most critical sort, which is often ignored but has never been controverted by the unscientific school of educators and the speculative school of psychologists.

The evidence is good as far as it goes; and one may freely admit that it does not go far enough. That it goes no farther is not the fault of the geneticist, but of the psychologist. While a small body of able men is now steadily building up a Psychology of Individual Differences, some of the most brilliant members of the profession are preferring to deal with affirmations and verbal concepts rather than with facts. If a luxuriant new hypothesis seems to make it necessary, this type of psychologist appears to feel no hesitation about covering inheritance with a cloud of dust and then asserting that the concealed object never existed. It is not surprising that some educators have been misled by this sort of procedure.

The geneticist objects to any continuation of it. The mass of exact and critical quantitative evidence for the inheritance of mental traits is still intact. Though we cannot yet isolate particular functions of the brain and show the precise mechanism by which they are inherited, we have nevertheless ample evidence to show that they *are* inherited—that, in general, the basic differences of the mind are as much due to ancestry as are differences of the body.

German Horse-Breeding and the War

The German Genetic Association has published a large volume investigating the war's effect on horse-breeding. A review of the industry prior to the war is given, then the effect of mobilization is described. Details are given of the part played by various breeds in the field and how well they have met expectations. The evil effects of war on the industry are analyzed and means suggested of overcoming them and keeping horse-breeding up to a high level: it is suggested, for example, that the best breeding stock should not be exposed to danger, and, on the other hand, that all stock which shows itself particularly valuable during the actual experience of war should be noted, and used as much as possible for breeding subsequently. The practical but all-inclusive nature of the book forms a good testimonial to the usefulness of the *Deutsche Gesellschaft für Züchtungskunde* which could prepare and publish it in the middle of the war, as it has done.

An Experiment in Sunflower Breeding

Sunflower seeds form an important source of oil in Russia and Th. Sazyperow has therefore undertaken to breed a strain which will be resistant to rust and other plant diseases. He crossed *Helianthus annuus* with *H. argophyllus* and describes the first two hybrid generations in the *Bulletin of Applied Botany*, Petrograd, May, 1916. Rust resistance is reported to be a Mendelian recessive, inherited separately from certain forms of leaf which were thought to be important in preventing the development of rust. It will be recalled that Biffen found rust resistance in wheat was also an inherited character. The discovery that disease resistance in plants is an aspect of Mendelian heredity, opens up a wide field for practical and theoretical advances in genetics. Mr. Sazyperow is continuing his researches.

MIMICRY IN BUTTERFLIES

Close Resemblances between Species May Be Protective, but Their Origin Is Difficult to Explain through Natural Selection

A Review

THE theory of mimicry in butterflies is one of the most attractive of the fascinating speculations which the early Darwinians put forward. It has long been part of the stock in trade of the text-book writer; but for a long time, too, there have been protests against the theory.

R. C. Punnett, Professor of Genetics in Cambridge University, has now collected the evidence in a beautiful book, lucidly written and illustrated with colored plates.[1] The work is a good example of the way in which many lines of biological investigation may be brought to a focus to throw light on a problem in evolution.

"Mimicry," Prof. Punnett says, "is a special branch of the study of adaptation. The term has sometimes been used loosely to include cases where an animal, most frequently an insect, bears a strong and often most remarkable resemblance to some feature of its inanimate surroundings. Many butterflies with wings closed are wonderfully like dead leaves; certain spiders when at rest on a leaf look exactly like bird-droppings; 'looper' caterpillars simulate small twigs; the names of the 'stick-' and 'leaf-' insects are in themselves an indication of their appearance. Such cases as these, in which the creature exhibits a resemblance to some part of its natural surroundings, should be classified as cases of 'protective resemblance' in contradistinction to mimicry proper. Striking examples of protective resemblance are abundant, and although we possess little critical knowledge of the acuity of perception in birds and other insect feeders it is plausible to regard such resemblances as being of definite advantage in the struggle for existence. However, it is with mimicry and not with protective resemblance in general that we are here directly concerned, and the nature of the phenomenon may perhaps best be made clear by a brief account of the facts which led to the statement of the theory.

ORIGIN OF THE THEORY

"In the middle of the last century the distinguished naturalist, H. W. Bates, was engaged in making collections in parts of the Amazon region. He paid much attention to butterflies, in which group he discovered a remarkably interesting phenomenon. Among the species which he took were a large number belonging to the group Ithomiinae, small butterflies of peculiar appearance with long slender bodies and narrow wings bearing in most cases a conspicuous pattern. When Bates came to examine his catch more closely he discovered that among the many Ithomiines were a few specimens very like them in general shape, color and markings, but differing in certain anatomical features by which the Pierinae, or 'whites,' are separated from other groups. Most Pierines are very different from Ithomiines. It is the group to which our common cabbage butterfly belongs and the ground color is generally white. The shape of the body and also of the wing is in general quite distinct from what it is in the Ithomiines. Nevertheless in these particular districts certain of the species of Pierines had departed widely from what is usually

[1] Mimicry in Butterflies, by Reginald Crundall Punnett, F.R.S., Fellow of Gonville and Caius College, Arthur Balfour Professor of Genetics in the University of Cambridge. Pp. 188, price 15 shillings. University Press, Cambridge (Eng.), 1915.

regarded as their ancestral pattern and had come to resemble very closely the far more abundant Ithomiines among whom they habitually flew. To use Bates' term they 'mimicked' the Ithomiines, and he set to work to devise an explanation of how this could have come about. The "Origin of Species" had just appeared and it was natural that Bates should seek to interpret this peculiar phenomenon on the lines there laid down. How was it that these Pierines had come to depart so widely from the general form of the great bulk of their relations, and to mimic so closely in appearance species belonging to an entirely different group, while at the same time conserving the more deep-seated anatomical features of their own family?

USEFULNESS OF CHANGE

"If the change was to be regarded as having come about through the agency of natural selection it must clearly be of advantage to the mimicking forms; otherwise natural selection could not come into operation. What advantage then have the Ithomiines over the majority of butterflies in those parts? They are small insects, rather flimsy in build, with comparatively weak powers of flight, and yet so conspicuously colored that they can hardly be mistaken for anything else. In spite of all this they are little subject to the attacks of such enemies as birds, and Bates attributed this to the fact that the juices of their bodies are unpalatable. According to him their striking and conspicuous pattern is of the nature of a warning coloration, advertising their disagreeable properties to possible enemies. A bird which had once attempted to eat one would find it little to its taste. It would thenceforward associate the conspicuous pattern with a disagreeable flavor and in future leave such butterflies severely alone. The more conspicuous the pattern the more readily would it be noticed by the enemy, and so it would be of advantage to the Ithomiine to possess as striking a pattern as possible. Those butterflies showing a tendency to a more conspicuous pattern would be more immune to the attacks of birds and so would have a better chance of leaving progeny than those with a less conspicuous pattern. In this way variations in the direction of greater conspicuousness would be accumulated gradually by natural selection, and so would be built up in the Ithomiine the striking warning coloration by which it advertises its disagreeable properties. Such is the first step in the making of a mimicry case—the building up through natural selection of a conspicuous pattern in an unpalatable species by means of which it is enabled to advertise its disagreeable properties effectively and thereby secure immunity from the attacks of enemies which are able to appreciate such advertisement. Such patterns and colors are said to be of a 'warning' nature. The existence of an unpalatable model in considerable numbers is the first step in the production of a mimetic resemblance through the agency of natural selection.

BEGINNING OF CHANGE

"We come back now to our Pierines which must be assumed to show the general characters and coloration of the family of whites to which they belong. Theoretically they are not specially protected by nauseous properties from enemies and hence their conspicuous white coloration renders them especially liable to attack. If, however, they could exchange their normal dress for one resembling that of the Ithomiines it is clear that they would have a chance of being mistaken for the latter and consequently of being left alone. Moreover, in certain cases these Pierines *have* managed to discard their normal dress and assume that of the Ithomiines. On theoretical grounds this must clearly be of advantage to them, and being so might conceivably have risen through the action of natural selection. This indeed is what is supposed to have taken place on the theory of mimicry. Those Pierines which exhibited a variation of color in the direction of the Ithomiine 'model' excited distrust in the minds of would-be devourers, who had learned from experience to associate that particular type of coloration with a dis-

A COMMON AMERICAN CASE OF MIMICRY

These two butterflies are familiar to everyone who has observed insects in the United States, and are generally regarded as offering an example of mimicry. Their coloring, a rich brown and black, is even more similar than their pattern. Below is the Monarch butterfly (*Danais archippus*) which is supposed to be unpalatable and shunned by birds after they have had one taste; above is the Viceroy (*Limenitis archippus*) belonging to a totally different family which is supposed to be edible. By mimicking the appearance of its larger and distasteful neighbor, it is supposed that the Viceroy secures protection from attacks by birds. Photographs natural size. (Fig. 8.)

agreeable taste. Such Pierines would therefore have a rather better chance of surviving and of leaving offspring. Some of the offspring would exhibit the variation in a more marked degree and these again would in consequence have a yet better chance of surviving. Natural selection would encourage those varying in the direction of the Ithomiine model at the expense of the rest and by its continuous operation there would be built up those beautiful cases of resemblance which have excited the admiration of naturalists."

Following Bates' work in South America, Alfred Russell Wallace developed the theory for the butterflies of the Indo-Malayan region, and Trimen for those of Africa. In each instance abundant cases of supposed mimicry were found.

MÜLLER'S CONTRIBUTION

"We may now turn to one of the most ingenious developments of the theory of mimicry. Not long after Bates' original memoir appeared attention was directed to a group of cases which could not be explained on the simple hypothesis there put forward. Many striking cases of resemblance had been adduced in which both species obviously belonged to the presumably unpalatable groups. Instances of the sort had been recorded by Bates himself and are perhaps most plentiful in South America between species belonging respectively to the Ithomiinae and Heliconinae. On the theory of mimicry all the members of both of these groups must be regarded as specially protected owing to their conspicuous coloration and distasteful properties. What advantage, then, can an Ithomiine be supposed to gain by mimicking a Heliconine, or vice versa? Why should a species exchange its own bright and conspicuous warning pattern for one which is neither brighter nor more conspicuous? To Fritz Müller, the well-known correspondent of Darwin, belongs the credit of having suggested a way out of the difficulty.

"Müller's explanation turns upon the education of birds. Every year there hatch into the world fresh generations of young birds, and each generation has to learn afresh from experience what is pleasant to eat and what is not. They will try all things and hold fast to that which is good. They will learn to associate the gay colors of the Heliconine and the Ithomiine with an evil taste[2] and they will thenceforth avoid butterflies which advertise themselves by means of these particular color combinations. But in a locality where there are many models, each with a different pattern and color complex, each will have to be tested separately before the unpalatableness of each is realized. If, for example, a thousand young birds started their education on a population of butterflies in which there were five disagreeable species, each with a distinct warning pattern, it is clear that 1,000 of each would devote their lives to the education of these birds, or 5,000 butterflies in all. But if these five species, instead of showing five distinct warning patterns, all displayed the same one, it is evident that the education of the birds would be accomplished at the price of but 1,000 butterfly existences instead of five. Even if one of the five species were far more abundant than the others, it would yet be to its advantage that the other four should exhibit the same warning pattern. Even though the losses were distributed *pro rata* the more abundant species would profit to some extent. For the less abundant species the gain would, of course, be relatively greater. Theoretically, therefore, all of the five species would profit if in place of five distinct warning patterns they exhibited but a single one in common. And since it is profitable to all concerned, what more natural than that it should be brought about by natural selection?"

TWO TYPES OF MIMICRY

There are thus two generally accepted types of mimicry—the Batesian, where one species adopts the coloration of another, and the Müllerian, where a number of species adopt a common pattern. As to the facts, there is no room for dispute, but there is much room for dispute about the explanation of the facts.

Wallace pointed out that there are five necessary conditions which must and do exist in any case of mimicry:

1. That the imitative species occur in the same area and occupy the very same station as the imitated.

[2] "In attributing this quality to the butterflies in question I am merely stating what is held by the supporters of the mimicry theory. I know of scarcely any evidence either for or against the supposition."

2. That the imitators are always the more defenseless.

3. That the imitators are always less numerous in individuals.

4. That the imitators differ from the bulk of their allies.

5. That the imitation, however minute, is *external* and *visible* only, never extending to internal characters or to such as do not effect the external appearance.

It is true, Prof. Punnett says, that these conditions often hold good, but there are few if any cases where they all hold good. When the problem is further examined, still more difficulties are found. For instance, the butterfly is frequently captured by birds on the wing; but though two species may resemble each other closely in coloration their manner of flight is sometimes so different that it is hard to believe a bird would not see the difference between them.

Breeding experiments offer a further objection, Prof. Punnett thinks, to the idea that the mimetic pattern has been built up by natural selection from a long series of small changes. For the patterns are found to be inherited as Mendelian units and therefore, he thinks, must have appeared by one large step instead of a number of small steps: otherwise we should recover some of the intermediate steps by cross-breeding. It is not certain, however, that this argument deserves as much weight as Punnett ascribes to it.

DO BIRDS DISCRIMINATE?

Distinctly more convincing is the experimental evidence on the preferences of birds. For when they are given a chance to select between a mimic and a model, they sometimes choose the supposedly unpalatable one and reject the one which resembles it, but is, by hypothesis, comestible. If enough evidence of this sort could be accumulated, it would obviously strike at the very foundations of the mimicry hypothesis.

"It is safe to say," Punnett thinks, "that a number of species of birds have been known to attack butterflies—that a few out of the number feed upon butterflies systematically—that some of the most persistent bird enemies devour the presumably protected forms as freely as the unprotected—but that in a few instances there is some reason for supposing that the bird discriminates. Beyond this it is unsafe to go at present."

Monkeys eat butterflies readily, and appear to be more discriminating than birds. It is not impossible that they are really responsible for the establishment of some species of mimicry; for Punnett shows by mathematical calculations that even a small percentage handicap of one species is sufficient to alter its relative numbers greatly in a comparatively small number of generations. In 1850, for instance, the peppered moth *Amphidasys betularia* was common in England; at present it has been practically supplanted by a darker form, *A. doubledayaria.* The cause of this change is obscure; it is suggested that the darker form may be hardier.

The rôle of natural selection in mimicry is still further limited by a consideration of what must happen in the early stages. If a white butterfly is to assume the protective coloration of a dark form, it appears that a small spot of dark color (which, according to the selectionists, would be the start of the change) would give no real protection. Prof. Punnett declares, "Till the mimic can be mistaken for the model, natural selection plays no part. . . . The part now often attributed to natural selection is to put a polish on the resemblance and to keep it up to the mark by weeding out those which do not reach the required standard."

From these facts, and others which have not been mentioned in this review, the author holds "that there are difficulties in the way of accepting the mimicry theory as an explanation of the remarkable resemblances which are often found between butterflies belonging to distinct groups. Of these difficulties two stand out beyond the rest, viz., the difficulty of finding the agent that shall exercise the appropriate powers of discrimination, and the difficulty of fitting in the theoretical process involving the incessant accumulation of minute variations with what is at

present known of the facts of heredity."

"Looked at critically in the light of what we now know about heredity and variation, the mimicry hypothesis is an unsatisfactory explanation of the way in which these remarkable resemblances between different species of butterflies have been brought about."

PUNNETT'S EXPLANATION

Punnett's own explanation tends to bring mimicry into the field of mutation and Mendelian heredity. He suggests that the number of different inherited factors for pattern and color, in butterflies, is quite limited, so that the same assortment may not infrequently be brought together even though the group whose members exhibited the resemblance might, owing to structural differences, be placed in different families. In support of this he cites the analogy of the rodents, where the number of different hereditary factors for coat color is small, and the same colors may be found in the rabbit, the mouse and the guinea-pig.

"On this view the various color patterns found among butterflies depend primarily upon definite hereditary factors the number of which is by no means enormous. Many of these factors are common to several or many different groups, and a similar aggregate of color factors, whether in an Ithomiine, a Pierid, or a Papilio, results in a similar color scheme." When a case of mimicry is thus established, practically by accident, natural selection may perhaps preserve it; but natural selection in this view can receive no credit for creating the mimicry, as the older naturalists thought. This explanation is of course largely hypothetical, and Punnett does not pretend that the evidence is sufficient to prove it.

One can hardly deny, however, that he has made out a strong case against the omnipotent adequacy of natural selection to explain mimicry in butterflies. And the book is significant as an expression of the widespread modern objection to the *allmacht*, the all-sufficiency of natural selection as a factor in evolution, which marked the preceding generation and which still characterizes many popular writers and even a large number of biologists who are working in other fields and not in touch with the developments of genetics.

It was once thought that, if an adaptation appeared to be useful to the individual, natural selection could be invoked to account for its origin. Most geneticists now want to be shown. It is clear to them that natural selection might preserve a case of mimicry, but it is not clear to them that it could build up a case of mimicry, starting with merely trivial variations.

Natural selection as a factor in evolution is probably more firmly established today than ever before. But its place is also more sharply defined than ever before, and it is no longer universally admitted to be responsible for creating adaptations. Many biologists reached this standpoint years ago, and the attacks being made on one stronghold after another of the extreme selectionists have been successful. The attack on the natural selection explanation of mimicry in butterflies is only one of a long series which has resulted in giving a much clearer understanding of what natural selection can do and what it cannot do. For this reason, as well as for its own interest, Prof. Punnett's book deserves wide consideration.

Research in Inebriety

A research foundation has been organized at Hartford, Conn., under the directorship of Dr. T. D. Crothers, the object of which is to make a scientific study of alcoholism and inebriety. The foundation is to be endowed and will become a permanent institution. Appeals are to be made to physicians all over the country to furnish records and histories of cases in order that they may be classified and studied for the purpose of determining the laws that govern inebriety outside of the direct effects of alcohol. The institution will serve a practical end as well as becoming a center for research.—*Eugenical News.*

THE JUKES IN 1915

Huge and Notorious Clan Brought to Light by Dugdale Is Now in Its Ninth Generation—Members Have Moved to Good Environments but in Many Cases No Improvement in Their Character Is Visible—In Other Cases, by Eugenic Marriages, They Have Taken Places in Respectable Society

A Review[1]

In 1874, Richard L. Dugdale, a New York merchant[2] who was interested in prison reform, made a tour of the counties to study jail conditions. In one mountain county he found six blood relatives in prison for various offenses, and undertook a study of their heredity. The result was the publication, in 1877, of his study of the story[3] of their clan, to which he gave the fictitious name of "Juke." Ever since then, it has been regarded as the example *par excellence* of bad breeding. Its origin was commonplace enough.

"Into an isolated region, now within 2 hours' railroad journey of the nation's metropolis, there drifted nearly a century and a half ago a number of persons whose constitutions did not fit them for participation in a highly organized society. This region was the frontier of that day and those who went there had many of the characteristics of our western frontiersmen of a century later. Some of them were hunters, some were extreme nomads (tramps), and like practically all extreme nomads were addicted to drink; some were miners and found at this place opportunity to make a living at an occupation that requires no capital and which may be readily abandoned or resumed; some were neurasthenic, found muscular activity and persistence in work irksome, and craved stimulants to lighten the labor of even minimum activities; some were feebleminded, and had found that Nature makes fewer demands on intelligence than does organized society; and still more were feebly inhibited and had either already so violently offended the *mores*, as to flee the 'revenge' of society, or had found that there was less tendency to repression of their intermittent, instinctive outbreaks where the arm of organized society was not yet long enough to reach. For all of such socially inadequate this retired, well-wooded and well-watered valley afforded a haven of refuge at a day when the system of state 'institutions' had been little developed.

"That there should be such strains in a colony that had been founded only three or four generations before is not strange when we recall that the emigration of criminals and ne'er-do-wells, among others, to this new country was assisted, in order to relieve the congested centers of Europe, of some of those whose presence was incompatible with the development of high civic ideals. It is the descendants of such people, among others, that came to the region which the Juke family made notorious.

THE EARLY JUKES

"Here are some of the migrants or their immediate progeny: Max, the hunter and fisher, the jolly, alcoholic, ne'er-do-well; Lem, the stealer of sheep; Lawrence, the licentious, free with his 'gun.' Here, too, were found Margaret and Delia, the wantons, and Bell, who

[1] The Jukes in 1915. By Arthur H. Estabrook of the Eugenics Record Office. Pp. 85. Published by the Carnegie Institution of Washington, September, 1916.

[2] Dugdale was born in Paris, of English parents, in 1841. In 1851 the family came to New York City. Dugdale acquired a competence in commercial life and then devoted himself to philanthropy. He died in 1883.

[3] The Jukes: A Study in Crime, Pauperism, Disease and Heredity. By R. L. Dugdale. New York and London, G. P. Putnam's Sons, 1877. The book has gone through four editions.

had three children by various negroes. So some negro and, doubtless, some Indian blood became in time disseminated through the whole population of the valley.

"The progeny of such stock showed the expected reactions to their primitive environment. Some proved themselves feebleminded, grew up ineducable, slovenly, and inefficient, ending their lives in the poorhouse. Some became vagrants, wandering hither and thither and sometimes disappearing from view altogether. Great numbers craved drink and regarded it as the greatest good and were unable to control in any degree their use of it as long as they had money or could be trusted for it. Great numbers saw no need of regulating and, indeed, many were unable to regulate their reactions to sex impulses; so that they lived lives of grossest promiscuity in sex relations. Some showed an ugly and quarrelsome disposition. Others, like Ann Eliza, became delusional and homicidal. Indeed, assault and battery, murder, and rape are rather common, especially among the illegitimate children of Ada.

"Not only was much of the original stock bad, but improvement which might otherwise have occurred was prevented by constant inbreeding. The nervous weaknesses, the mental insufficiencies were thus brought together from *both* sides and mentally and morally defective offspring were rendered more certain. Some outbreeding there was and where it was with better stock, the progeny had better intelligence and emotional control and lines were founded that were able to hold a good position in organized society.

"Such were the Jukes a generation or two ago, when Dugdale studied them."[4] In 1911 his original manuscript was found, giving the real names and localities of the members of the clan, and with this as a clue the Eugenics Record Office wisely started to bring the study up to date, through the agency of Arthur H. Estabrook, who had already made a somewhat similar study of the "Nam" family, another great group of cacogenics.

FAMILY NOW SCATTERED

The Jukes in Dugdale's time had lived largely on the industry of cement mining in their county; shortly afterward this was abandoned, with the introduction of Portland cement, and eventually almost the entire clan had to emigrate. Estabrook found it scattered over fourteen States, and personally visited every member whom he was able to trace. Dugdale had described 709 individuals; Estabrook brought the number to 2,820, of whom 2,094 are of Juke blood; the others represent people who have married into that family.

In their original habitat the Jukes naturally had a bad environment—which they themselves had created. They likewise had a "bad name" and were of such evil repute that they were handicapped in business and social relations. When they left the valley, they went to places where their name was unknown and carried no stigma, where they had a fresh start and no handicaps. The Eugenics Record Office sought to determine what influence forty years of these varied environments had had on the old stock. Did they become useful citizens when they had a fair chance and a square deal, or did they make a new but equally bad environment wherever they went?

Estabrook's book consists mainly of a detailed description of these people, including those found by Dugdale as well as those now living. It is accompanied by extensive genealogical charts. Dr. Davenport summarizes their record as follows:

"First, on the whole, the later descendants of the Jukes, in Connecticut, in New Jersey, even in Minnesota, still show the same feeblemindedness, indolence, licentiousness and dishonesty, even when not handicapped by the associations of their bad family name and despite the fact of being surrounded by better social conditions. This is because, wherever they go, they tend

[4] The preceding paragraphs are from a preface which C. B. Davenport contributed to the work under review.

A HOME OF THE JUKES

This two-room log cabin is occupied at the present time by a member of the Juke family. Some members of the great clan are useful members of society, but entirely too many of them, living in such places as this, are a burden whom society would be much better off without. It is not sufficient to move them into a better environment, for investigation shows that to a large extent they create their own environment—a bad one—wherever they go. Photograph from Arthur H. Estabrook. (Fig. 9.)

to marry persons like themselves. On the other hand, the dispersion has led some of these descendants to marry into better stocks and this is improving the quality of the germ-plasm. To be sure, this better germ-plasm into which the Jukes marry will sometimes become contaminated with the determiners for mental weakness and lack of control; but children who show such defects are more apt to be placed under restraint in their matings when they belong to families of fair social standing than when they arise in cacogenic communities. It is probable that, in the long run, the cheapest way to improve a bad germ-plasm is to scatter it. I do not, however, recommend this course as superior to segregation; but only as a cheap and somewhat hazardous substitute. In the case of the Jukes there are so many *dominant* traits of feeble inhibition that scattering them is like scattering fire-brands—each tends to start a fire in a new place. One may doubt the wisdom of the operation of 'Children's Aid Societies' which send much bad germ-plasm to good farming communities throughout our Middle West. It will probably have, on the whole, the same sad effects that the transportation of convicts from London to Virginia and later to Australia have had on parts of those countries.

GOOD HEREDITY ESSENTIAL

"The most important conclusion that may be drawn from Dr. Estabrook's prolonged study of the Jukes forty years later is that not merely institutional care, nor better community enviroment, will cause good social reactions in persons who are feeble-minded and feebly inhibited, although, on the other hand, better stimuli will secure better reactions from weak stock than will poor stimuli. There is, indeed, no conflict between environment and heredity; each is a factor in all behavior. Environment affords the stimulus; heredity determines largely the nature of the reacting substance;

the reaction, or behavior, is the resultant or product of the two. The great mistake that social agencies have made in the past is that they have overlooked the constitutional or hereditary factor of the reaction. The chief value of a detailed study of this sort lies in this: that it demonstrates again the importance of the factor of heredity."

A more detailed examination gives little encouragement to those social optimists who think that Nature cures such plagues as the Jukes by bringing them gradually to extinction. With the increase of charity, of baby-saving devices, and misguided philanthropy, bad breeding tends rather to increase. The average fecundity of the Juke women is stated to be 3.526 children or, if those who have no children are excluded, 4.025 per female. From 20 to 30% of the births have been illegitimate.

Of the 2,094 Jukes enumerated, 1,258 are now living in this country. "Although many are old, the great majority are now in the prime of life and reproducing continually. The younger[5] generation is still in school.

"The Jukes of today are to be found in all classes of society. The good citizen, prosperous and rearing a family with good moral and mental stamina, has earned his place in the community. Then there is the more numerous class, composed of steady, hard-working persons who toil from day to day at semi-skilled or unskilled labor and make no deep impression on the community, but rear their children as well as their limited outlook on the world will allow, endeavoring at least to raise them to the parental social level. Again, there is the scum of society represented among the Jukes. These are inefficient and indolent, unwilling or unable to take advantage of any opportunity which offers itself or is offered to them. These form the real social problem of the Jukes today.

SOME USEFUL JUKES

"An attempt has been made to classify the living Jukes into these three classes. There are 748 Jukes over the age of 15 considered in this connection. There are, roughly speaking, seventy-six in the first class, the socially adequate; 255 individuals are doing fairly well; 323 are typical Jukes of the kind described by Dugdale, and ninety-four were unclassified, due to lack of sufficient information. The writer realizes that these figures mean little except to give a comparative idea of the general proportion of the three classes. As time goes on many of the younger ones classed as 'doing poorly' may, through added responsibility and as the result of experience, enter the second or even the first class. Those who remain, not profiting by experience, are the mentally deficient, for whom nothing can be done except to give continual oversight or custodial care."

Consanguineous marriage in the group is studied with care and the inference drawn "that cousin marriage in the lines where there is mental defect tends to reproduce that defect and intensify it; but when there is mental and moral strength in certain characters on both sides there may, in certain matings, arise offspring who are superior to either parent." The inheritance of eroticism and pauperism are similarly studied, but the results are hardly conclusive, in view of the difficulty of defining such traits and of separating out the environmental influences. Criminality is believed to be largely feeble-mindedness.

It was not to be expected that this study would throw much light on the heredity of specific traits, for it was not undertaken with that view, but with a view to determine the effect of a changed environment. Estabrook divides his treatment of the latter subject into "involuntary removals" and "voluntary removals." In describing the latter, he seems to overlook the fact that those who migrate voluntarily are likely to be superior to the average, or they would not have sufficient enterprise to migrate. A fairer test of environmental influence is involuntary

[5] This evidently refers to the eighth generation. The ninth generation so far includes only two individuals.

removal, under which head he lists 118 individuals who, before the age of 21, were placed in some institution (excluding jail and prison). Even here, however, it may be doubted whether the environment of a poorhouse is a particularly elevating one, most of all when the individual is grown up before being taken there. The number of children of known parentage who were placed in a really good environment while very young is not great enough to warrant any conclusions. Dr. Estabrook's conclusions should be taken with reserves:

"The institution, then, does not permanently improve the condition of some. These react afterwards in society as their sibs do who have not been in institutions. These have not inherited and so do not possess the potential traits which others can work upon and train. On the other hand, as has been stated above, many are helped and improved by institutional care and training. These individuals have a better inheritance and set of traits to develop and their better response to the new environment is due to the possession of those traits which can be molded and shaped by proper contact with others, so that in society they become good citizens."

The inferences are reasonable, but not adequately proved by the present evidence.

PUNISHMENT A FAILURE

Another 118 Jukes have been in penal institutions, and as the investigator remarks, "penal servitude as a cure for crime in the Juke family seems to have been a failure, as a feeble-minded person cannot be made normal through any sort of punishment."

Under the head of "eugenic matings" we are told that "a rough classification of the 399 fertile marriages among the Jukes gives 176 eugenic matings and 223 cacogenic matings. In the opinion of the writer, who has studied the people and their offspring, 55% of the matings are detrimental to the forward progress of the Juke family, while 45% may be considered eugenic or beneficial. The standard of a eugenic mating has been put low, as it is desired to give everyone the benefit of the effect of environment. Had these cacogenic matings been forbidden or if offspring had been prevented by sterilization, it is safe to say that in the next generation less than 5% of the whole offspring would have shown undesirable traits. As it is now, with unrestricted reproduction, over half the offspring either is mentally defective or has anti-social traits." It is to be supposed that Dr. Estabrook made these statements after careful study, but to the superficial study of the reviewer they seem too sanguine, in view of the large number of anti-social traits that are recessive. The so-called eugenic matings may be of immediate benefit to the Juke family, but it is to be feared that in the long run many of them will be highly detrimental to the nation at large.

Finally, as to the bill which the law-abiding citizens of the State must pay: Dugdale estimated a loss to society by the Juke family from 1800 to 1875 of $1,250,000, not including the drink bill. In the ensuing forty years Estabrook thinks the bill has grown to $2,093,685. "If the drink bill is added, this total becomes $2,516,685. It is estimated that $648,000 of pension money has been paid to the Jukes. Much, if not most, of this has been spent for whisky and the rest has furnished support which in most cases would otherwise have been furnished by pauper relief."

To counterbalance this, there are the earnings of the few Jukes who have been really productive. Three individuals are particularly mentioned, whose total earnings are believed to be $160,000; others have been self-supporting but little more. On the whole, there is very little offset to the bill. In a more eugenic age, such a clan as the Jukes will be looked on by Society as an unnecessary luxury.

Finally, Estabrook's general summary will be given in full, although the reviewer thinks some of the statements need qualification:

"The primary aim of this work is to present the facts of the lives of the

Jukes. For the past 130 years they have increased from five sisters to a family which numbers 2,094 people, of whom 1,258 were living in 1915. One-half of the Jukes were and are feebleminded, mentally incapable of responding normally to the expectations of society, brought up under faulty environmental conditions which they consider normal, satisfied with the fulfilment of natural passions and desires, and with no ambition or ideals in life. The other half, perhaps normal mentally and emotionally, has become socially adequate or inadequate, depending on the chance of the individual reaching or failing to reach an environment which would mold and stimulate his inherited social traits.

"There have been cited just previous to this certain cases of good citizens among the Jukes. In these men and women the bad traits which have held down their brothers and sisters have become lost and they are the fountain heads of new families of socially good strain. Heredity, whether good or bad, has its complemental factor in environment. The two determine the behavior of the individual. The social reformer and the student of eugenics must see that, no matter what the degree of perfection to which we raise the standard of the environment, the response of the individual will still depend on its constitution and the constitution must be adequate before we can attain the perfect individual, socially and eugenically.

"This study demonstrates the following:

"1. Cousin-matings in defective germplasms are undesirable, since they produce defective offspring irrespective of the parents' somatic make-up.

"2. There is an hereditary factor in licentiousness, but there are those among the Jukes who are capable of meeting the requirements of the *mores* in sex matters if only great social pressure is brought to bear on them.

"3. Pauperism is an indication of weakness, physical or mental.

"4. All of the Juke criminals were feebleminded, and the eradication of crime in defective stocks depends upon the elimination of mental deficiency.

"5. Removal of Jukes from their original habitat to new regions is beneficial to the stock *itself*, as better social pressure is brought to bear on them and there is a chance of mating into better families.

"6. One in four of the Jukes is improved socially by care in Children's Institutions.

"7. Penal institutions have little beneficial influence upon persons of defective mentality.

THE REMEDY

"The natural question which arises in the reader's mind is, 'What can be done to prevent the breeding of these defectives?' Two practical solutions of this problem are apparent. One of these is the permanent custodial care of the feebleminded men and all feebleminded women of childbearing age. The other is the sterilization of those whose germ-plasm contains the defects which society wishes to eliminate.

"The first is practicable, since there are now many custodial institutions for the feebleminded and epileptic and in some of these the patients are partly self-supporting. These institutions should be increased in number and capacity to receive all the defectives now at large and who must be cared for if the program of segregation is to be fully carried out. Out of approximately 600 living feebleminded and epileptic Jukes, there are now only three in custodial care. It is estimated that at the end of fifty years the defective germ-plasm would be practically eliminated by the segregation of all of the 600.

"Sterilization of those carrying epilepsy, feeblemindedness, etc., is entirely practicable.[6] Public sentiment, however, does not favor such a practice. Contrary to public belief, sterilization would interfere with the real liberty of the individual less than custodial care."

[6] Dr. Estabrook and Dr. Davenport have both emphasized the extreme sexual license of the Jukes, and their infection with venereal disease. These facts seem to the reviewer to make sterilization unthinkable. Life-long segregation for both men and women is the only remedy which will adequately safeguard both society and the individual Jukes.

WOMEN'S EYES AND POTATO SKINS

WHEN a photograph of the Keys quadruplets was published in the May issue of this Journal, a number of members commented on the eye color of the girls. It had been suggested that the four children probably represented the "identical" type of plural births; that is, the case where a single fertilized egg-cell splits up, at the beginning of development, and a complete individual is produced by each separate half, or quarter as the case may be. Ordinary twins are produced by the fertilization of two separate egg-cells, and they are therefore not expected to be any more alike than ordinary brothers and sisters. But identical twins or quadruplets, being in reality only one individual divided up, are expected to show the astoundingly close similarity which is occasionally found in life as well as in literature.

If the Keys quadruplets are of this identical type, it was asked, how can it be that three of them have brown eyes, while the eyes of the fourth are very clearly blue? The difference is easily seen in Fig. 10, and is confirmed by a letter from the father, who writes that three have brown hair and eyes, while Leota is a "a perfect blonde."

Now we have no proof that these quadruplets are "identical," in the genetic sense. The fact that they are all of one sex, and show a considerable resemblance, causes one to think that they may be. The fact that Leota has blue eyes is not necessarily evidence that they are not merely four quarters of one original egg. Prof. R. Ruggles Gates of the University of California has pointed out, in a letter to this Journal, that the discrepancy might be explained in the way that E. M. East

ROBERTA MONA MARY LEOTA

THE KEYS QUADRUPLETS ON THEIR FIRST BIRTHDAY

Leota has the distinction of blue eyes, while the three others have brown. It is suggested that, like her sisters, she may have inherited the brown pigment, but that she lost it at some time while the eyes were developing. Such a loss of an inherited factor is often seen in plants. Photograph copyrighted by F. M. Keys. (Fig. 10.)

THE QUADRUPLETS AND THEIR MOTHER

Mrs. Keys is 35 years old and weighs about 150 pounds. She has borne four children previously. The quadruplets, until they were nine months old, had no other food than mother's milk. This photograph, showing them at the age of one year (arranged in the same order as in Fig. 10) is copyrighted by F. M. Keys. (Fig. 11.)

has explained the occurrence of potatoes with white skins.[1]

The tuber of the wild potato has a purple skin, but in cultivation nowadays we find two types, one with a purple skin and the other with a white skin. The latter corresponds to albino forms of other plants; it is light colored merely because the agent that normally produces pigment is not present.

East found, as a result of inquiries and of his own breeding experiments, that colored skin and white skin formed a contrasted pair of Mendelian characters. Color was dominant, and the white skin could appear only if color was lacking. If a colored potato and a white potato were crossed, the offspring were all colored; on the other hand when a white-skinned variety was propagated asexually, by its tubers, it remained white generation after generation.

But when a purple-skinned variety was propagated by tubers, it did not invariably remain purple, generation after generation. All of a sudden, the purple might disappear, and one or more plants would be turned up with white-skinned tubers.

Propagation being asexual, this loss of color could not be due to hybridization. It is the kind of a change which goes under the name of bud-variation, and East decided that it represented the dropping out of the character "color" at some time when the vegetative cells of the potato were dividing, during its period of growth.

Study of similar bud variations in other plants convinced him that the same thing was occurring there.

[1] Annual report of the Connecticut Agricultural Experiment Station, 1909-10, pp. 134–140.

Seventy-five per cent of the cases, he thought, could be explained by the hypothesis[2] that "There has been simply the *loss* of a *dominant* character and hence the appearance of a *related recessive* character."

This hypothesis has been accepted by most geneticists as a good explanation of the sudden change of potato skins from purple to white. And as Dr. Gates has pointed out, it can also explain the sudden change of a girl's eyes from brown to blue; for brown and blue, in the human eye, appear to be related to each other in the same way that purple and white are in potato skins; the darker color is dominant and the lighter one recessive.[3]

Now a field of potato plants, propagated by tubers ("eyes") really represents just so many parts of a single individual. Similarly we may assume that these quadruplets represent just so many parts of a single individual. It is not asserted that this is the case, for we have no real proof. We make the assumption for the sake of illustration. If the assumption is correct, then the blue in Leota's eyes appeared because the brown dropped out, just as in one potato the white may appear because the purple drops out. The parallel is a homely one, but it strikingly illustrates the fact that heredity in man follows the same laws as heredity in the lower animals, and in plants. It is introduced here merely to point out that individuals are not necessarily all alike, even if they have identical heredity, as identical twins have and as potatoes or other plants propagated asexually have. There is always the possibility of "somatic segregation," which produces white-skinned potatoes and might be responsible for Leota's azure orbs.

Emigration after the War

Eugenicists have called attention to the problems which may be presented by immigration from Europe after the war, but an editorial in the New York *Times* suggests another problem which has not been foreseen. Steamship passenger agents are quoted as saying that there will be a great exodus from the United States when peace is declared, many aliens going home to help rebuild their native countries. It is estimated that a million may go back, and that half of these will stay back. As evidence of the truth of this view, they point to reservations already made for passage, by citizens of warring nations.

Those who are patriotic enough to go home and take part in a period of reconstruction are likely to be a superior lot of people, and from a eugenic viewpoint the United States can ill afford permanently to lose half a million such residents, particularly if their places are filled by undesirable immigrants who may have been unsettled by army life until they are unwilling to go back to their old occupations.

The *Times* concludes: "Those who look for a great many immigrants say that some will come to avoid heavy taxes, some because they are unwilling to return to European mines and mills from the armies in which they have served, and others—a host of widows and orphans—to be helped by relatives and friends here. But it is admitted that several European nations will probably prohibit emigration, and that Great Britain plans to find land for her disbanded soldiers in Australia, New Zealand, and South Africa. Predictions that a great number will come to this country are based upon arguments and reasoning that may be sound, but in the deposits of passage money the steamship agents have solid facts."

[2] Plant World, XI (1908), pp. 77–83.

[3] The father of the quadruplets writes that his wife has blue eyes, as have all her "folks." She is, then, homozygous for blue, and the brown must have come through her husband. He states that he and his eleven brothers and sisters all have dark eyes, that they "take after my mother." "My mother's people all have dark hair and eyes," he continues; "my father has blue eyes as most of his family have." The ancestry of the quadruplets is therefore full of blue eyes, and it is certain not only that there is blue in Leota's eyes, as is easily seen, but that there is also blue in the eyes of her three sisters, although it cannot be seen because it is overlaid with the dominant brown.

ARE MORE BOYS BORN IN WAR TIME?

IT IS acknowledged that the present war will leave a great dearth of males in Europe, but it is sometimes alleged that Nature provides a compensated sex-ratio in births during and after such periods. Readers of Westermarck's "History of Human Marriage" will remember that, in Chapter XXI. he quotes many supposed authorities to show that more boys than usual are born as a result of a great war or other period of hardship. The facts, if substantiated, would be of importance to eugenics, but Westermarck's handling of statistics is highly uncritical, and few outside of the profession are able safely to weigh questions of vital statistics. It is therefore of interest to have the opinion on this point of Prof. Walter F. Willcox, of Cornell University, one of the foremost American statisticians. Writing to the Syracuse *Post-Standard*, he said:

"It is common opinion among statisticians that the excess of males in the total births increases during or shortly after a destructive war. American birth statistics are meager and unsatisfactory and consequently we have little American evidence for or against the opinion. The only bit I know of is derived from Massachusetts, where the excess of male births during the five-year period of the Civil War was slightly greater than in any earlier or later period since 1850, as the following figures show:

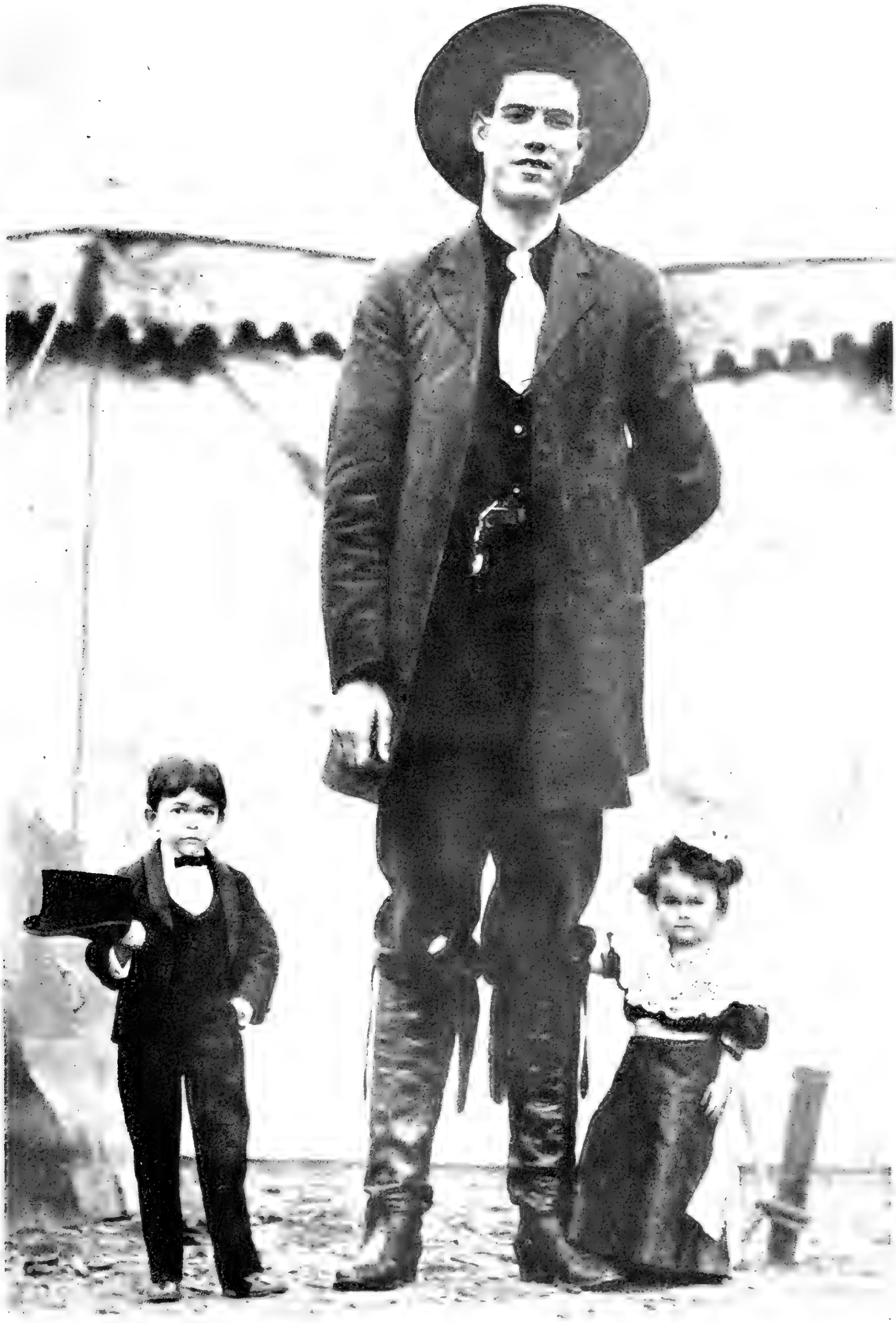
Period	*Male births to 1,000 femal·*
1851–55	1,068
1856–60	1,063
1861–65	1,077
1866–70	1,065
1871–75	1,068
1876–80	1,065
1881–85	1,062
1886–90	1,058
1891–95	1,055
1896–00	1,057
1901–05	1,062
1906–10	1,056
1911–13	1,061

"Among European writers, von Oettingen wrote in 1882: 'The more the female population in any country exceeds the male as a result of any disturbing influence, the larger the proportion of males in the children born;' and von Mayr, a better authority, wrote in 1897: 'After wars apparently a larger proportion of male children are born.' Finally, in Prinzing's *Medical Statistics*, published in 1906, is the statement that 'after wars the excess of male children is said to increase. Düsing speaks of this as a well-known fact which has never been doubted and von Fircks shows it from the figures for Germany after the wars of 1866 and 1871.' But Prinzing adds that the increase did not appear in France after the war of 1871.

"The statistical evidence is too slight to demonstrate the existence of such an increase in the proportion of male children born after a war, but does make it possible, if not probable."

Foundation to Teach Mothercraft

Nearly a million dollars is left in the will of Mrs. Lizzie Merrill Palmer, widow of former U. S. Senator Thomas W. Palmer, to found a school where girls may be taught motherhood, according to the daily press. The will provides that girls unable or unwilling to pay the cost of their board at the school shall be educated free of charge. "I hold profoundly," says the will, "the conviction that the welfare of any community is divinely and hence inseparably dependent upon the qualities of its motherhood and the spirit and character of its homes." It is specified that the school be established in Detroit or the township of Greenfield, a suburb. Girls of ten years and upward will be admitted.



A giant and two dwarfs from a circus. Stature is made up of so many different items that it has been very difficult to analyze its inheritance. Mendelian writers are accustomed to say that cases of dwarfism in which all parts of the body are reduced proportionately (as in the two above) are a recessive to normal stature, but there are probably many different factors involved. Hereditary differences in some of the ductless glands of the body are thought to be, in part at least, responsible for great extremes of stature. Photograph from René Bache. (Fig. 12.)

The

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A HOUSE-FLY ESCAPING FROM VENUS' FLY TRAP

The plant will catch and devour any sizable insect that comes along; but small ones, even though the leaves have closed upon them, are allowed to escape as not being worth eating, just as a fisherman throws the small fish back in the stream because it would be more trouble to clean and cook them than they are worth. The above photograph, posed and highly enlarged, shows a house-fly emerging from the interior of the leaf, by crawling between the spikes.

Frontispiece.

THE HUMAN MACHINE

A Mechanistic View of Life Which Conceives Man as Being Merely a Venus' Fly-Trap Many Times Multiplied—The Kinetic System for the Transformation of Energy—Origin and Function of the Emotions

A REVIEW

ONE school of biologists has long looked upon all life from a "mechanistic" point of view, holding that there is nothing mystical about a living being, but that if our knowledge were sufficient we could resolve its whole life into reactions; we could interpret everything in terms of physics and chemistry, with no unexplainable residue, no "soul" or "vital principle" left over.

Dr. George W. Crile, Professor of Surgery in Western Reserve University (Cleveland, Ohio) has applied this hypothesis to his study of man and has brought the researches of many years together in a substantial volume[1] under the title of "Man—An Adaptive Mechanism." Taking his stand with orthodox Darwinians—one might even say, with primitive Darwinians—Dr. Crile believes that everything in the human body can be interpreted as an adaptation, the result of the long process of evolution and the constant struggle for survival.

"The fact is," he informs us, "that the present form of man is the result of an inconceivably long and tedious process of addition and subtraction, of grafting character upon character in somewhat the same haphazard fashion as in certain mountains in South America stones are thrown by the wayfarer upon a lone Indian grave. Some land securely and augment the mound, while others fall at random and roll away, the desired result being achieved, however, a memorial to the one who lies beneath the pile. If the result of man's haphazard assemblage of organs is to some extent adequate to the needs of his present environment, it is because during the age-long processes of evolution all the fatally awkward combinations have been eliminated by a struggle so keen that the slightest variation in the length of a leaf, the strength of a limb or the color of an egg, has given the victory to a rival species."

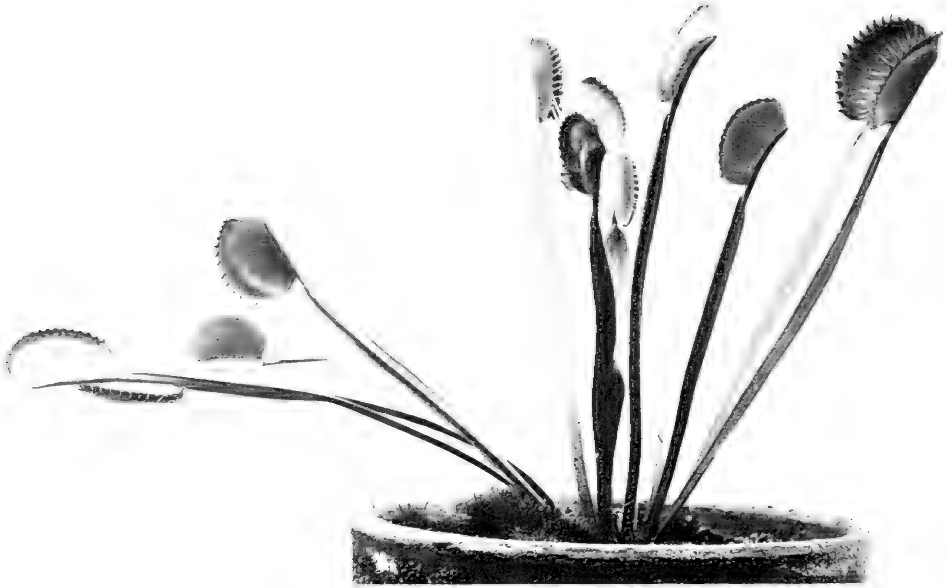
A good many geneticists would question the truth of this statement; but the value of Dr. Crile's book does not lie in his contributions to genetics. He does not attempt to show in any instance *how* a certain adaptation has arisen—indeed he seems not to realize that there is any difficulty about this; but in explaining the usefulness of some structure, once it has arisen, he makes out a very plausible case.

"The test of utility," he tells us, "may be applied to internal processes as well as to external manifestations in custom and social forms of man's peculiar mode of adaptation by nervous reactions. On this basis man's claim to a superior place among animals depends less upon *different reactions* than upon a *greater number* of reactions as compared with the reactions of 'lower animals.' Ability to respond adaptively to more elements in the environment gives a larger dominion, that is all."

THE NATURE OF "MIND"

"Mind," the word we use to express the reactions of man's nervous mechanism, "is no phenomenon apart and distinct from other functions of the nervous system. Indeed, mind, as we

[1] Man—An Adaptive Mechanism. By George W. Crile, F.A.C.S. Edited by Annette Austin, A.B. Pp. 387, price $2.50. New York, The Macmillan Co., 66 Fifth Avenue, 1916. The photographs of Venus' Fly-Trap, illustrating this review, were made for the JOURNAL OF HEREDITY by John Howard Payne from a specimen furnished by Frederick V. Coville of the Bureau of Plant Industry.



VENUS' FLY-TRAP

This, the most interesting of the insectivorous plants, grows only in a small area on the coast of North Carolina. Although it draws most of its nourishment from the ground and the sun, like other plants, yet it is not entirely healthy and vigorous unless it has animal food. Several of the leaves on this plant are closed, having caught insects which they are now in the process of digesting. The process of digestion usually requires two or three weeks, after which the leaves open to reject the remains, but usually are never again active. Sometimes, however, the same leaf has been made to digest several insects in succession. (Fig. 1.)

find it in the 'lower walks' of life, is not confined to animals. Many plants exhibit in response to external stimuli protective reflexes which are analogous to the nervous reflexes of man. Notable among these are the drooping leaves of the sensitive plant when it is lightly touched, and the movements by which the Drosera and Venus' Fly-Trap capture and digest their prey when they are excited by the touch of an insect."

"In other words, the complex organism differs from the simple only in the number of its reacting units and their attunement. It would seem, therefore, that the manifold reactions of man differ only in number and complexity, but not in principle, from the simple adaptive reactions of Venus' Fly-Trap."

This plant "possesses one of the most remarkable adaptive mechanisms in nature." It "evinces just as much power of perception and discrimination as is shown by the amoeba; indeed, almost as much as is shown by many highly differentiated organisms, such as the frog, for example. The fly-trap catches flies, eats and digests them and ejects the refuse. The frog does the same, responding to the adequate stimulus of the sight of a fly just as the fly-trap responds to its touch. Both the frog and the fly-trap catch insects by comparable motor mechanisms. Each depends on an adequate stimulus for the excitation of the mechanism as a result of which stored energy is set free to be manifested in the fly-catching reflex. Each then digests and assimilates the caught insect and when hungry catches another insect.

"If the reactions of the human organism be reduced to their simplest terms, probably none will be found more

intricate than this food-catching reaction of Venus' Fly-Trap and the frog. The principal difference between these three living mechanisms is rather a difference in the range of activation by environment, resulting in the frog and in man in a larger number of reactions which in turn involve more complex effector mechanisms than are possessed by the fly-trap. Each reaction of man doubtless has more component parts than each reaction of Venus' Fly-Trap, just as a large house contains more bricks than a small house.[2] The most complex machine ever invented by man looks like a grotesque monster to the savage; yet its complex movements are compounded of the two simple movements of translation and rotation."

THE WORKING OF THE MACHINE

If we similarly try to analyze the reaction of the fly-trap, we find three distinct stages:

1. The application of an adequate stimulus from without, *i. e.*, the touch of a fly.

2. Conduction of this stimulus from the tip of the sensitive filament to the motor mechanism of the plant.

3. The chemical and motor end effect, involving all the acts and organs used in closing the lobes and the killing and digestion of the insect.

"In the three separate stages of *adequate stimulus*, *conduction* and *end effect* which compose the reaction of Venus' Fly-Trap, we find all the essential factors which enter into the life activities of man. Under *adequate stimulus*, for instance, are included the activating stimuli produced by heat and cold, dust, débris, microörganisms, food, air, water, light, poisons, blows—and by certain physical and chemical changes within and without the body, to which man through 'evolution' has become adapted through the creation of an adaptive response. *Conduction* is supplied by the central and autonomic nervous systems, that is, by the organs of touch, taste, sight, smell, hearing, pain, and by the chemical receptors for the initiation of certain reactions of chemical control. *End effects* are found in all the vital processes of motion and emotion, muscular activity, chemical change, psychic states, growth, nutrition, reproduction, thought, invention, social forms, government, war, religion, business, in short, in all the activities by which man's life is distinguished from the immobility of the rock."

Such is the attitude toward life of the mechanistic school. It is, of course, open to criticism, but this is not the place to criticize it. Let us rather examine the details.

"As we have seen, the presence of the adequate stimulus is the first requisite for reaction. As the lobes of the fly-catching plant close only upon the arrival of the insect stimulus, so every conceivable act, thought, or function, of the human body, requires an adequate stimulus for its manifestation, that manifestation depending absolutely upon the previous experience of the organism or of its species with that stimulus. That is, the response to any stimulus depends wholly upon the biologic necessity which led to its

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[2] It is well known that Venus' Fly-Trap, the sensitive plant (*Mimosa pudica*), and other plants possessing the power of motion can be chloroformed, when their movements are stopped just as in animals. On this point Dr. Crile contributes the following note giving a "comparison of anesthesia in plants possessing a motor mechanism and in animals:"

"In peripheral nerves after exposure for varying periods of time to vapors of the various fat solvent anesthetics, *e. g.*, chloroform, ether and ethyl alcohol, there is an increase in the amount of potassium in the medullary sheaths as shown microchemically by the potassium reagent of Macallum. A similar increased amount can be demonstrated as the result of mechanical or chemical injury. In those plants possessing a motor mechanism, *e. g.*, *Mimosa pudica* and *Dionaea muscipula*, after exposure to the same fat solvent anesthetics there is a marked increase in the demonstrable potassium compounds. This increase occurs in the guard cells, in the chlorophyll granules, in certain modified conducting elements, but to the greatest extent in those areas of the plant which are most active in producing motion and which upon stimulation show a considerable turgor. Lipoid substances as demonstrated by osmic acid and scarlet red have the same distribution as the potassium compounds. In plants as in animals the lipoid substances which contain potassium, *e. g.*, lecithin and cholestrin, after the application of these anesthetics become so altered in their physical constitution that the contained potassium compounds can enter into the chemical combination with the reagent applied."

LEAVES OF THE FLY-TRAP

On the inner surface of each are three or four delicate hairs or filaments, not visible in the photograph. A heavy touch of these, such as might be made by a falling stick, usually produces no result; neither does a light touch such as a raindrop would give. And even a single touch of the right firmness causes no activity—so carefully is the plant protected against wasting energy on "false alarms." But if it is touched delicately twice in quick succession, as might be done by a crawling insect, the two lobes of the leaf immediately close and begin to secrete a digestive fluid. For a while the victim can be heard buzzing frantically inside; then the sides of the prison collapse and pin him firmly; a few weeks later nothing remains but his skeleton. (Fig. 2.)

evolution. The response to a sharp blow by pain and retreat from the offending point; the response to an insect-like tickle by the desire to scratch; the response to a soft, caressing contact by pleasure and approach, are all specific to the species and the self-protective necessities as a result of which they were evolved in the organism. Similarly, the more obscure and delicate responses of thought and sentiment, of 'study,' 'invention,' 'ambition,' 'industry,' 'joy,' 'sadness,' 'remorse,' are all dependent upon specific stimuli in the environment and are specific to one or another of the biologic purposes of self-preservation, nutrition or procreation."

THE USE OF TICKLISHNESS

Some of these reactions to stimuli may have been of use once but are of little value under the conditions of modern civilization; "for just as the organism is slow in evolving adaptations to newly developed factors in the environment, it is slow in discarding adaptations to an older environment, even such as may be a hindrance to life under present conditions. Such a relic of prehistoric peril is the tickle reflex. It is more strange than appears at first glance that the tickle reflex can be excited only in certain parts of the body, by but two types of tactile impression, and that it is invariably accompanied by a self-protective reaction. One type of the tickle reflex is elicited by a light running motion on the surface of the skin, which produces a sensation like that produced by a crawling insect, with an irresistible desire to scratch or rub the affected part. A sharp impact causes pain, but if the adequate stimulus of contact which simulates the crawling of an insect be applied again and again in the same spot, it will cause each time the same tickling sensation. This reflex was undoubtedly developed at a time when insects were a great menace to life, and when only those individuals who evolved an effective defense were able to prevail. It may even supply an explanation of man's loss of hair in the upward march, since the presence of hair would provide ambush for the insect enemy, and its loss, together with the evolution of the tickle sensation, would greatly facilitate defense."

"A second type of tickle reflex is elicited by heavy penetrating pressure in the region of the ribs, the loins, the base of the neck and the soles of the feet—the pressure simulating the penetrating contact of a tooth-shaped body. The reaction in this case is a violent discharge of energy in the form of laughter with cries for mercy and frantic muscular efforts to be free if the stimulus be continued. If one were tied hand and foot and were vigorously tickled for an hour, he would probably be as completely exhausted as if he had run a marathon race or sustained a crushing injury; indeed, victims of torture in the Middle Ages were often killed by prolonged tickling.

"The fact that these ticklish areas are found in those parts of the body which are still and must always have been the points most frequently attacked by savage beasts leaves little doubt that this reaction developed at a time when man's progenitors, like the carnivora of today, fought their enemies face to face with tooth and claw, and that this mechanism was acquired as a means of protection against valiant foes."

THREE KINDS OF REACTIONS

Tears, sneezing, coughing and vomiting are among the other protective adaptations which Dr. Crile describes as being based on contact stimuli. There are other adaptations which are based on chemical stimuli. And finally, there is a third class of reactions, much greater in extent, which is based on the stimulation of what he calls "distance ceptors." He explains:

"Adaptation to environment in some species of animals, such as the oyster, is secured mainly by reactions to stimulation of the contact and chemical ceptors only; but in most animals there has been evolved a third method of adaptation to environment by which they are directed toward beneficial objects in their *distant* environment and away from those that are harmful, thus

securing a quicker and surer adjustment than would be possible through contact and chemical ceptors only." In the third class of stimuli the animal *as a whole* responds, whereas responses to the contact and chemical stimuli usually involve only a part of the organism. This does not, however, change the essentially mechanical character of the occurrence. "The flight of the giant water buffalo at the sight of a lion, or the charge of the lion at the sight of its prey, is as automatic a reaction as is the withdrawal of the limb of a rabbit from the sharp prick of a thorn." The emotions offer good illustrations of this third class of stimuli. Fear, for example, is said by Dr. Crile to be intended to prepare the body to seek preservation by flight. "Striking evidence of the truth of this assumption is afforded by the fact that fear is experienced only by animals which depend for self-defense and species-preservation upon a swift locomotor reaction. The skunk, for example, whose chief means of protection is its odor; the porcupine, defended by its quills; the snake which repels its enemies by its venom; the turtle which is securely encased in its shell; the lion and the elephant secure in their superior strength—exhibit little fear, if any. On the other hand, the rabbit, the bird, the deer, the horse, the antelope, the monkey, and man—species which have ever had to struggle for their existence against stronger or swifter enemies—these are the animals which preeminently exhibit fear and an irrepressible desire to flee from danger."

The mechanism of fear is further discussed, and its effects are declared to depend largely on increased activity of the thyroid gland, the adrenals, the liver, and other glands, the secretions of which are either increased or diminished. "In the light of this evidence many phenomena of fear and of other emotions may be explained. It is known, for instance, that men and animals under the stimulus of strong emotion possess an extraordinary amount of physical strength. This is explained by the fact that fear drives certain organs and inhibits others, so that every particle of available energy is concentrated upon the fighting mechanism. The advantage that this power must have given to prehistoric man in his struggles against superior foes in a wild environment is apparent to anyone who will allow his imagination to revert to those days of supreme physical contest. But that the tendency should persist today, in spite of the disappearance of most of the stimuli to active physical combat, so that, at the slightest hint of danger, man's energies are drained, exactly as in the days of physical struggle, is one of the misfortunes of our insufficiently adapted state.

THE EFFECT OF FEAR

"So strong is the force of these ancestral acts, so firmly established the action pattern of muscular response to fear stimulus, that now, whether a business catastrophe or an attacking enemy threaten, fear is expressed in terms of the ancestral flight to safety or fight for life which took place in the remote brute period of human history. In spite of the fact that by harnessing the forces of nature, and by social coördination, which reduces the number of motor reactions, man has progressed vastly in his methods of acquiring food and avoiding danger, his body still responds to the threatened moral or financial disaster, as if the old need for physical contest remained. His heart beats wildly; his respirations are quickened; he trembles and turns cold; his knees shake; beads of sweat stand upon his brow; he is pale and his mouth is dry; he feels faint and he may collapse. Whether the cause of fear be moral, social, financial or intellectual, the result is the same."

"As fear activates the body, so all emotions and psychic states activate the body and exhaust energy in proportion to the degree in which they represent the physical activity attendant upon the phylogenetic forms of self-defense. As fear recapitulates the ancestral act of flight from the enemy, so rage or anger recapitulates the act of attack and in like manner activates

THE REMAINS OF A FEAST

None of the leaves of the plant here pictured contained flies, but several of them held the remains of the little land crustacean commonly known as the sow-bug. The photograph above shows an opened leaf, much enlarged, with the chitinous skeleton of its victim, from which all the meat has been dissolved. The acid secretion of the plant is almost colorless and slightly mucilaginous. The most common food of the plant, when wild, is beetles, but it will eat spiders and almost anything that comes too close to it. Obviously, however, flies, bees, etc., more frequently escape than do insects which have less power of flight. (Fig. 3.)

the muscles that would be used were the physical fight made."

From such cases as have been cited Dr. Crile concludes that "the adaptation of man and kindred animals to environment is secured by a series of physical and chemical reactions which are the outward expressions of a transformation of energy, by which the forces latent in food products that have been appro-

priated and stored in the organism are released to produce heat and motion." He then undertakes to find the mechanism that thus transforms energy. A long series of experiments, which cannot be described here, leads to the conclusion that "only the brain, the thyroid, the adrenals, the liver and the muscles are chiefly concerned in the transformation of energy." "They merit therefore the distinction of being termed the *kinetic system*."

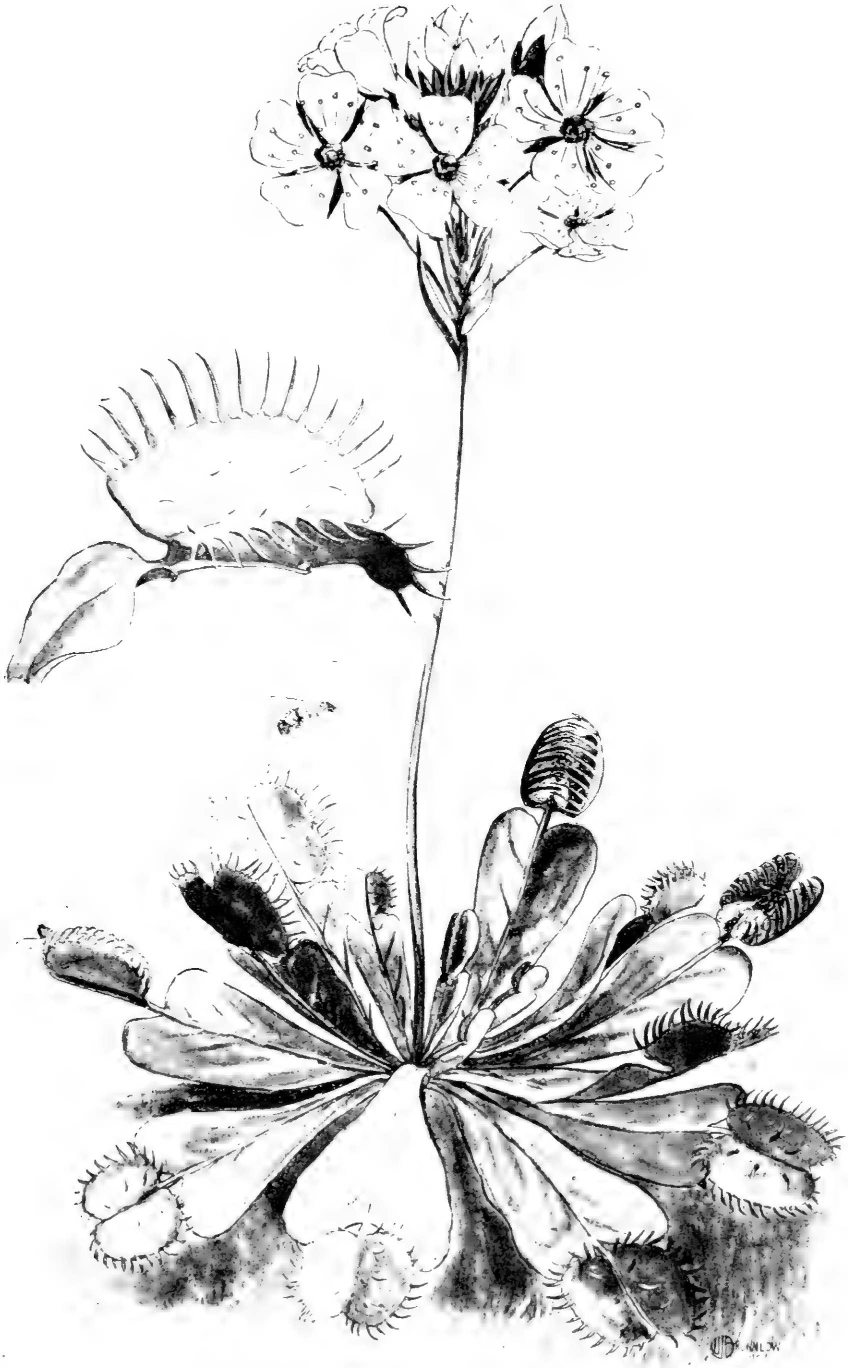
This brings him to his particular field of medicine and surgery—the field which he primarily wanted to investigate, for he felt that medical science was falling behind, because of its failure to adopt an evolutionary outlook.

"The postulate that there is in the body a kinetic system, consisting mainly of certain organs, which are driven by the stimuli of the outer and inner environments of the body, throws light upon many problems of the medical clinic, as well as of human relations. According to this postulate, the body is a mechanism integrated and driven by the brain in response to adequate stimuli—contact, distance and chemical—arising within and without the body. The phenomena of health and disease are manifestations of the activity of this system. When the body mechanism is driven at a moderate speed by an environment to which the capacity of the body is perfectly adjusted, the result may be compared to that following the driving of any other machine by a careful and considerate master—a maximum of work done, with a minimum of wear and tear on the parts. When for a short period of time or continuously the driving is at an excessive pace, there results a sudden or a gradual breakdown, involving always the weakest link in the mechanism."

The observation that the degenerative diseases to which man is subject are not the same, in general, as those which attack woman, leads to an interesting speculation on the difference in nature of the kinetic systems of the two sexes. "The adrenals preëminently control the mechanism for increasing motor efficiency during short periods of increased transformation of energy. The adrenals are the organs most heavily involved in muscular work. On the other hand, the thyroid controls the mechanism which regulates energy transformation during longer periods of increased activation. It is known that the thyroid enlarges during sustained periods of increased activity, particularly during infection, adolescence and pregnancy. Throughout the ages of evolution, the male has been chiefly the motor member of the family; he has been, not exclusively, but for the most part, the hunter, the fighter, the searcher for food—activities which have required increased transformation of energy during short periods of time, with proportionally heavy demands upon the acid-neutralizing mechanism of the body. The female, on the other hand, has borne the burden of procreation and of the lighter but more constant domestic tasks, and has been correspondingly dependent upon the mechanism for sustained physiologic efficiency, represented chiefly by the thyroid. This age-long differentiation may conceivably have led to a corresponding differentiation in the physiologic expression of emotion, with a corresponding differentiation in the diseases caused by emotion. According to a striking statement made by Loeb, 'Man and woman are, physiologically, different species.'"

Dr. Crile goes on to illustrate the all-inclusiveness of the mechanistic philosophy.

"If emotion, particularly fear, causes such far-reaching metabolic disturbances, why does it not produce even more baleful consequences? Indeed, why has not emotion wrecked the race? Is it because there are now certain agencies at work in society, which hold in check this harmful tendency, as immunity and phagocytosis protect the organism against bacterial menace, and as the custom of wearing clothes and building houses is a protection from the dangers of cold and wind and hostile strangers? Has there been evolved in man some counter-adaptation which provides a partial protection against self-destruction from the too-long-retained motor adaptation which we term 'emotion?'



THE FLY-TRAP IN BLOOM

The plant produces its white flowers in July and August; in the fall it loses it long-stemmed leaves (such as are shown in Fig. 1), which appear in the spring, and in their place puts forth short, broad-stemmed leaves such as are shown in the above drawing. Leaves of this form seem to be more suitable for withstanding the winter climate, but they are much less active in fly-catching than are the spring leaves. The plant can be cultivated in greenhouses without much difficulty, and makes a fascinating object of study. Illustration from Crile. (Fig. 4.)

"In attempting to find an answer to these questions, we are led to contemplate the fact that physical benefit is derived from those factors in life, which solace and reassure the mind, which 'rejuvenate the spirit,' which dispel worry, and which substitute faith and tranquillity of mind for turmoil and terror. . . . On the principle that fear causes the dissipation and faith the conservation of potential energy, we can understand the far-reaching and abiding benefits of religion in all ages, among all peoples, throughout the whole human race, as far back as we have any record. . . . In thus placing faith, hope and charity on the same plane with muscular reflexes, in their power to conserve the life of the race, we but give them their proper place in evolution as adaptations which have arisen coincidently with the need for such modifications."

THE BRAIN-MECHANISM

We now return to the fly-trap for another lesson.

"We know that the brain contains the mechanism that drives the body; we know that environment drives the brain and that environmental forces reach the brain through the mediation of the sense organs. But what is the mechanism within the brain by means of which a given stimulus causes different effects in different brains? Why will one man run away and another attack on receipt of identical stimuli?

"We postulate that the adaptive reactions of the organism are executed by mechanisms, each of which, like a wireless station, awaits the arrival of the specific impulse which is to awaken it to specific response." In another paper he describes the brain as an organ that contains "innumerable patterns, each representing a mechanism for the performance of a specific act, and that the brain cells supply the energy—electric or otherwise—by which the complex act is performed, that the energy stored in the brain cells is by an unknown mechanism released by the force that passes over and activates the brain pattern; through an unknown property of these brain patterns each stimulus causes some change in the brain pattern in passing through it so that the next stimulus passes with greater facility. This property of facilitating a stimulus increases with repetition that particular mechanism's reception of the particular stimulus. This is the basis of education, of training, of establishment of the conventions, conduct, behavior, government—in short, the total behavior of the individual."

After describing the similarities between the reaction of Venus' Fly-Trap and a human reaction, Dr. Crile says:

"In Venus' Fly-Trap but one receptor and one effector mechanism has been evolved for but one adaptive reaction. In man many receptor and effector mechanisms have been evolved for numerous reactions in response to numberless stimuli.

MAN A COMPLICATED PLANT

"If it were necessary for Venus' Fly-Trap to catch its food by running, instead of by passive attraction, the plant would doubtless have evolved a mechanism coördinating the organism for running—in other words, a brain. The difference between Venus' Fly-Trap and man is the difference between the number of mechanisms possessed by each. A multiplication of the single action pattern of Venus' Fly-Trap equals the mechanism of man."

Thus is man reduced to a complicated sort of fly-trap.

Without going into the genetic and philosophical difficulties which this view involves, it may be said that as a working hypothesis in the field of medical and surgical research, the mechanistic view is likely to be exceedingly fruitful for, as Dr. Crile points out, medicine has developed as a sort of household necessity, without any very broad biological foundation: "lacking the resources of assured scientific data or the support of coördinated methods, it is no wonder that it is even now in a somewhat chaotic state." Dr. Crile's own contributions are noteworthy, and this review has unavoidably done him an injustice, in passing over masses of technical experiments which form the most original part of the book, and emphasizing biological principles which

are in many cases not new, but merely used by the author as stepping stones. Dr. Crile's own results are sufficient to prove that the mechanistic philosophy will lead to some interesting advances in physiology, surgery and medicine, even if its genetic foundations are not fully understood. And the results obtained by a great number of other investigators in the same field, while perhaps not so immediately put into practice as, for instance, Dr. Crile's method of preventing surgical shock, are not less of fundamental importance.

It is really astonishing that the evolutionary study of physiology should have been confined to such a small number of workers, during the last half century, and should have made so little impression on the layman, or even on the medical profession. Such books as the one under review, packed as it is with interesting facts and fascinating theories, of which only a few have been suggested here, cannot help but be of great use in stimulating that sort of study. And it is on exactly that sort of study—the study of man as a species, in relation to other species and to his own past history—that the social progress of the next century will largely depend.

Annual Meeting of the A. G. A.

Two general sessions of the American Genetic Association will be held in New York, December 26–30, in connection with the meeting of the American Association for the Advancement of Science. In addition there will be a number of meetings of each of the sections—plant-breeding, animal-breeding and eugenics. Members who desire to present papers should notify the secretary as soon as possible. Papers of suitable character will be published in the JOURNAL OF HEREDITY, particularly if they lend themselves to good illustration. As it appears that the program will be full, the length of papers will be limited to twenty minutes, unless special notice is given. Full details of the meetings will be published in the next issue of this journal.

Improvement of California Orange Groves

Owners of the largest orange groves in Southern California have already adopted the plan of keeping a record of the performance of each individual tree, and eliminating any trees that do not prove to be good producers, usually by top-working them with select buds. So far, however, it has not been found possible to get many of the owners of small groves to adopt this process. The California Fruit Growers' Exchange is now planning to assist the growers in securing the record of trees in these small groves, taking advantage of the fact that small growers do not pick their own fruit, but entrust the task to the local association of the exchange, which sends out a trained gang of men to pick the fruit. It is now proposed to add to each picking crew a man whose duty will be to make a record of the production of every tree; and this report, furnished to the owner of the grove, will enable him to supplant the bad yielders with trees of a better strain, in many cases by topworking the drone or undesirable individual tree. The exchange has for several years been working on the problem of standardizing the citrus *pack;* a cooperative and organized effort is now being made to standardize the *production.*

MULES THAT BREED

Occasional Cases Reported, Some of Them with Good Evidence—Two Recent Cases in America—Studies of Germ-Cells Indicate that Chance of Mule Breeding is Very Slight

Orren Lloyd-Jones

Associate Professor of Animal Husbandry, Iowa State College, Ames, Iowa

During the three or four thousand years in which mules have been habitually produced, there have been many conflicting statements of fact and theory in regard to the question of possible fertility among these animals. Numerous incidents and cases are on record calculated to prove that mules occasionally exhibit generative powers. The affirmative side of the case may be opened by the French zoologist André Sanson ('88), who uncompromisingly maintains (Vol. III, p. 145) the occasional fertility of female mules. He says "it does not seem inadmissible that the males of the same origin as the females which show themselves so easily fertile, would not themselves behave similarly," and again "if there are fertile males, as we are sure at present that there are fertile females . . ." Sanson's claims are unusually broad—most writers are more conservative.

N. S. Shailer ('95) comments on the "singular fact that in only two or three cases have mules become fecund." Cossar Ewart ('93) states that mules are generally incapable of procreation, "though some exceptions to this rule have occurred." Whitehead ('08) in discussing the mule makes the parenthetical remark that "the cross between a female mule and a stallion is known to have resulted in offspring."

Stories accompanied by statements of eye-witnesses, of the birth of a foal by a mule, and affidavits as to the true hybrid nature of the mother, present obvious difficulties to those who would summarily set aside the whole matter of fecund mules as a thing of myth and anecdote. At the time of publishing the book on *Horses, Asses and Mule Breeding* in 1895, Tegetmier was a thorough disbeliever in all such cases, but in 1897, speaking of fertile mules, he mentions a case reported from Mexico and says that "this is one of the most detailed accounts of fertility in mules that has come under my notice," and urges caution in opinionating.

PREJUDICE IS STRONG

Skinner (Youatt, 1854) examined very carefully the first-hand evidence in regard to the celebrated Norfolk case of a breeding female mule and proved to his own satisfaction its authenticity. He also recognized the deep-seated prejudice which people have against giving credence to fertility among mules for he naively remarks that "Whatever doubt may arise hereafter, there is none now, of the truth of this case" (p. 432.) In this case the owner had noticed an abdominal enlargement in his female mule and had adjusted the shafts and harness to accommodate it, "but never suspected the mother's being in foal because it was contrary to nature." On April 23, 1834, she unexpectedly produced a colt. The mule had previously pastured with a 2-year-old stallion. Subsequently on August 13, 1835, the same mule produced another colt, a female. Both colts seemed normal, but died when a few months old.

Mr. Gun, an English military veterinarian in India, and apparently a faithful and efficient exponent of his profession presents (*Field*, September 17, 1898) in elaborate detail the events accompanying parturition in an Indian transport mule. This is indeed a case hard to refute.

Two cases recently reported have come before me and I have been able to

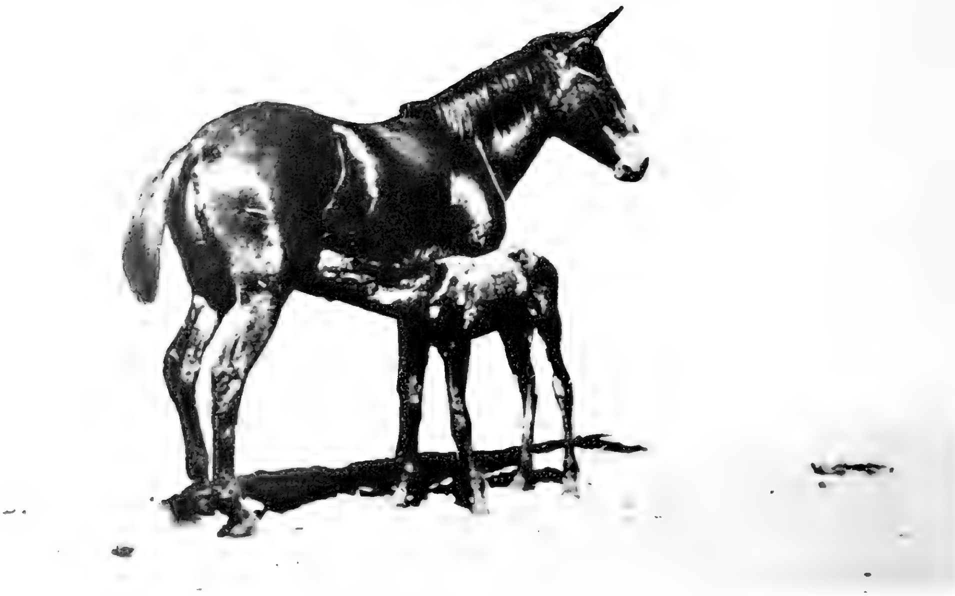
A HINNY WITH TWIN COLTS

The large animal here shown is said to be the offspring of a half-blood Percheron stallion and a black Spanish jennet, and her twin foals (one of which lived only a few days) are supposed to have been sired by a gray mammoth jack. The colts would therefore be three-fourths ass and one-fourth horse. (Fig. 5.)

collect some evidence on the matter, in the shape of statements and photographs.

One case first appeared in the November issue of the *American Journal of Veterinary Medicine*, Chicago, and again in *American Farming* for February, 1916. The facts presented below were furnished me by the owner and the veterinarian who attended the case. J. M. Bryant, of Quincy, Ind., about nine years ago bred a dark chestnut "half blood" Percheron stallion to a black Spanish jennet. The hinny thus produced is now 8 years old, 14½ hands high and weighs 900 pounds. Her whole aspect is very ass-like, especially her hind parts, but Mr. Bryant says her head has more the appearance of her sire—her ears being dark chestnut color, the same as the stallion. The tail shows a good brush or switch while the ass has a "rat tail." She has never brayed like a jennet. Some have doubted her breeding until they heard her voice, which resembles more the neigh of a horse. Twice before the present case this female produced foals, but in both cases the birth was abnormal and the colts died. Dr. L. A. Ray, the veterinarian who attended the birth in question, says of these earlier foals, "They were much deformed and were unable to swallow, and one had a double head from the eyes down."

This "hinny" was bred to a gray mammoth jack on July 7, 1914, and on July 11, 1915, produced the pair of twins shown in the cut (Fig. 5). The twins were both females. One was 25 inches high, black with white points, and lived only 7 days. The other was 30 inches high and gray in color. Dr. Ray on February 17, 1916,



SUPPOSED CASE OF A FERTILE MULE

The female is said to be out of a standard bred mare by a mammoth jack, which would make her a true mule. Bred to a black Percheron stallion, she is reported to have given birth to the colt shown, which would therefore be three-fourths horse and one-fourth ass. A better photograph of the colt is reproduced in the succeeding illustration. (Fig. 6.)

reports this colt as "very peculiar in make-up and very unthrifty." A letter from the owner, April 26, reports this gray colt (three-fourths ass and one-fourth horse) as doing well: "she seems to have the large bone of the horse above the knees, and below the knee the foot is small like a jack; it shows the Percheron one-eighth in the square hip. The colt makes a very peculiar noise, unlike any animal I ever heard."

Mr. Bryant has bred the "hinny" this year to a spotted Welsh pony and hopes to get a foal three-fourths horse and one-fourth ass. He says he has been about 10 years breeding for a "grade mule"—and if the present colt lives he believes he will "have the breed started."

Through the courtesy of Glen Hayes, editor of *American Farming*, the following case was called to my attention; the statements are quoted from correspondence with the owner, D. W. Sullivan, of Weed, Cal. Mr. Sullivan states that the female in Fig. 6 is out of a standard bred mare by a Mammoth Jack. This "mule" was put to a black Percheron stallion and on May 31, 1915, produced the male foal shown in the picture. The picture was taken when the colt was 3 days old. He is doing well at the present writing, and gives promise of developing into a valuable animal. He has a tail like a mule, and his feet are very small, long and narrow, again a mule-like trait. The owner states that "his actions are

A REPUTED "GRADE MULE"

The colt pictured in Fig. 6 is here shown at the age of one and one-half years. There is little visible evidence of the one-fourth ass blood which he is supposed to possess; but his owner says that his feet are mule-like, as are his actions. There are physiological reasons for doubting the accuracy of all stories of mules that breed, but many students have been willing to admit the fertile mule as a possibility. (Fig. 7.)

more like a mule than a horse. I have bred this mule again this spring and she only took the horse once. I think she will have another colt; if so I intend to start a breed of that kind."

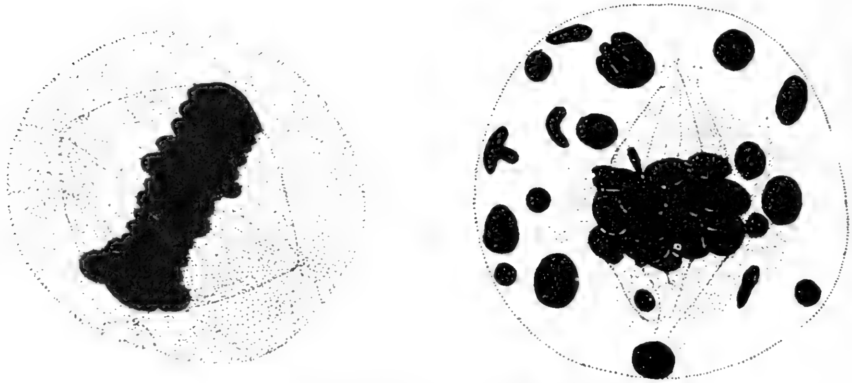
PHYSIOLOGICAL STUDIES

The ovaries of equine hybrids have not been frequently examined as have the testes. Ewart examined the ovaries of a zebra-horse hybrid of 10 years of age which had died. He found Graffian follicles present, one of them being $1\frac{1}{4}$ inches in diameter. A ripe follicle in a 16-hand mare is about $1\frac{3}{4}$ inches in diameter. "From the appearance of this follicle it might well have contained an almost ripe ovum." This case has encouraged Prof. Ewart to say that "occasional fertility among female mules is not inconceivable." Habenstreitt worked on the ovaries of a female mule and found follicles but no ova. Female mules exhibit regular periods of oestrum, but the exact seat of the cause of this cycle of changes is not clear.

But despite this chain of direct and circumstantial evidence the body of scientists has always been sceptical, and even mule breeders themselves as a class are inclined to discredit reports of fertility among mules.

The negative side of the question is stated boldly by Ayerault ('91), who unhesitatingly asserts that all cases of supposed fertility are errors in observation or recording. He says (p. 152) that "In Poitou, where 50,000 mares are annually used for mule production, fertile mules are unknown, although . . . they are in the best possible condition to be fecundated," since they are constantly pastured with stallions. In support of the negative side there are in general two lines of argument which are followed.

1. All reported cases are cast aside as mere myth and anecdote, or as due to



WHY THE MULE IS INFERTILE

When body cells divide there is no preliminary pairing of chromosomes. But when germ cells are formed each chromosome pairs with its mate as a necessary preliminary to division. In the case of the pure species this is a regular and orderly process as shown in the figure to the left. But in the germ cell divisions of the mule this is impossible as shown in the figure to the right. One trouble is that the hybrid has received nineteen chromosomes from his dam, a mare, and thirty-two from his sire, a jack; and when the chromosomes come to pair off there are not enough of the right kinds to pair. In addition there is an incompatibility between those "pairs" that are present and pairing is difficult or incomplete. The whole machinery of the cell is, therefore, upset and the cell itself destroyed. Camera lucida drawing, enlarged 3,000 times, from J. E. Wodsedalek (Biol. Bull., XXX, pl. I). (Fig. 8.)

faulty observation, or as due to wrong interpretation of facts. The cases reported are so rare that this is not a difficult undertaking.

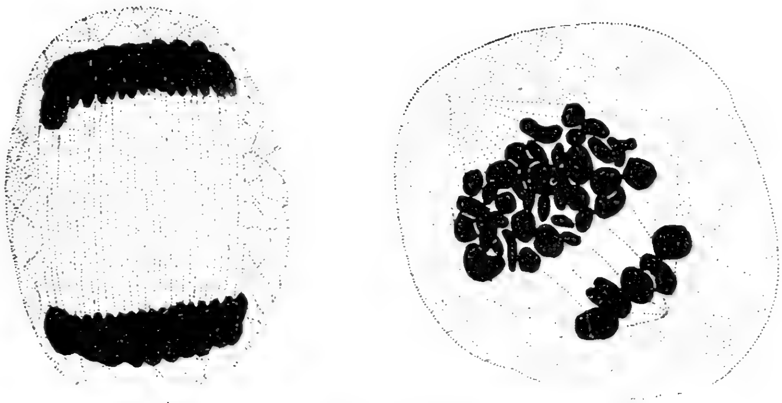
2. The germ glands, as well as the secretions discharged therefrom, of the hybrids are studied histologically and cytologically. These studies indicate a deep-seated derangement of the cell divisions which would, in normal, fertile animals, give rise to the fully developed germ cells.

SOME STRONG EVIDENCE

1. As to the first mentioned line of attack calculated entirely to disprove fertility among mules, *i. e.*, throwing all reported cases out of court as errors, it must be said that the facts as shown above in some cases are too strongly supported to be regarded as only fiction, and to be cast lightly aside; some way of "explaining" such cases is necessary. Those unwilling to give credence to the stories of fertile female mules, explain the "supposed cases" in one of two ways.

(*a*) The female may have produced a hybrid colt, but the real nature of this fertile female may not be known. Frequently horses of mixed breeding are seen which exhibit asinine traits of character, both externally and in disposition. If a female of this nature became pregnant, she might well be mistaken for a fertile mule. Such a case is doubtless the well-known instance in the Acclimatization Gardens in Paris. A female—supposedly a mule—produced foals when mated with both the horse and the ass. She was sold to the Gardens by some Algerian natives who alleged her to be a mule. It developed later that it was extremely doubtful whether the animal was a mule. The particulars of her parentage, etc., are utterly unknown, except as narrated by the Algerian horse traders and there were, as shown in a photograph reproduced by Tegetmeier and Sutherland, but vague suggestions of mule-like character about her. Her foals by an ass appeared to be ordinary mules and were sterile; her progeny by the stallion were horses which proved fertile.

In fact it is quite possible that the Sullivan case from Weed, Cal. (Fig. 6), belongs in this category. On examining Fig. 6 many readers will doubtless at



ORDER GIVES PLACE TO CHAOS

At the left is a perfect cell, showing the normal anaphase, half of the chromosomes going to each end. At the right is an abnormal division, due to the fact that the mule (a male, in this case) has not received the same number of chromosomes from each parent. Chaotic cell-division seems regularly to occur in adult male mules, so that all the germ-cells they produce are destroyed by internal causes. It is, therefore, doubtful whether a male mule can ever produce offspring. Camera lucida drawing, 3,000 times natural size, by J. F. Wodsedalek (Biol. Bull. XXX. pl. iv). (Fig. 9.)

once challenge the real hybrid nature of the dam. The "rat tail," the sparsely developed mane, the slightly excessive length of ear, as well as some lineaments of face and body difficult to describe, all suggest "mulishness" to be sure, but unprejudiced observers will pronounce her a very horse-like mule. To believers in telegony these cases offer little difficulty. Tegetmeier quotes Capt. Hayes, "a practical authority," as saying that "those animals which have been mistaken by superficial observers as fertile mules are really in most cases offspring of mares that have previously been bred to donkeys, and have given to their foals characteristics of their former lovers." Tegetmeier then proceeds to say in regard to the above female at the Acclimatization Gardens that "it is not a case of a fertile mule breeding, but that the animal is really an ordinary mare whose female parent was influenced by a first alliance with an ass."

Even though we do not now accept telegony as a fact, it is clear that here is a possible source of confusion in this debated field of fertility among mules, since belief in it by breeders of the past would tend to influence their accounts.

Disbelievers may also call Mr. Bryant's fertile "hinny" into question on a similar count, but it is interesting that this case hangs on the other horn of the dilemma. It is only with considerable circumspection that we can discover evidence in the appearance of this female which would enable her to establish a biological kinship with the nobler race.

ADOPTED OFFSPRING

(*b*) A second way in which supposed cases of fertile female mules may be accounted for is as follows:

The female in question may be a true mule, but the foal which she suckles was not borne by her. This brings up for consideration the phenomenon of lactation among female mules. Concerning this phase of the question there is little or no debate. Anyone long in a mule country will have seen cases of true lactation in mules. To be sure the mammary tissue is normally activated by conception, but on the other hand every dairy cattle breeder has seen lactation induced in young virgin heifers by constant suckling of a "poorly weaned" calf, and even males have been known to be stimulated to secrete milk. It is not difficult to suppose, for the few cases demanding it, a set of circumstances which would enable a female mule with maternal characteristics to develop active milk secretion at a time opportune for stealing and

fostering a foal born of a mare—perhaps one lacking maternal instincts. In herds of horses and mules it might easily happen that a milking mule should adopt an orphan colt and give every appearance of being the colt's true mother.

2. Facts from the second line of study, *i. e.*, examination of the cell processes going on within the testis, and of the nature of the seminal discharge, will now be considered. Cossar Ewart was among the first to subject the seminal fluid of equine hybrids to microscopic inspection. His hybrids were produced by use of a Burchell zebra male on pony mares.[1] The male "Zebroids" thus formed were unable to beget offspring in the many mares to which they were put, though, as is true of male mules produced in the ordinary way, their behavior gave every reason to suppose that they were breeders. In the discussion of his work, Ewart repeatedly mentions seeing incompletely formed spermatozoa which were "hardly at all motile due to the tail being only about twice as long as the head, while in the normal horse and zebra it is fully eight to ten times the length of the head." This seems like a case of arrested development. Ewart interpreted this lack of motility as evidence that these imperfect sperm cells were unable to make any headway against the outward currents which exist in the generative tract of the female. As a result they never reached the ovum, were of no use, and the zebroid was sterile.

Stephan in 1902 reported some studies on the structure of mule testes. Some of his material was taken from castration operations and some from animals which had died. His studies were histological rather than cytological. He reports an almost complete absence of seminiferous tubules, a great exaggeration of "parenchyma" tissue, and many other unusual features.

In 1905 appeared Iwanoff's "Untersuchungen über die Ursachen der Unfruchtbarkeit von Zebroiden."

In point of material his work is comparable with Ewart's, but in results it is different.

Iwanoff worked with two male zebroids, one 4 and one 5 years old. Microscopic examination of the seminal discharge showed complete lack of spermatozoa, but many round, hard, glancing, refractory, glass-like bodies were present. "In these cases one cannot speak of degenerate or undeveloped sperm cells. Ewart probably mistook the round glass-like bodies with Brownian movement for sperm cells. How Ewart's observation of a tail twice as long as the head, in the semen of his hybrid, is to be explained, I cannot say." Suchtet ('96), as the result of his work on mule testes, also concludes that the spermatozoids were replaced by "little round, brilliant, glassy bodies."

The presence of these round refractory bodies in the semen cannot be gainsaid, but it is questionable if they should be interpreted as "replacing" the spermatozoa. These bodies are probably merely masses of hard albumen, and not cellular bodies at all. Similar bodies may be seen in the semen of normal sheep, swine and rabbits, in which there is an abundance of live and perfect spermatozoa. After long standing these bodies seem to absorb moisture, increase in size, lose their refractory properties and disappear. It is possible that the testes of the mule play little or no part in furnishing the seminal discharge, but that it is secreted by the accessory glands of the generative tract.

DEGENERATIVE CHANGES

Iwanoff also made some observations on the histological structure of the testis of the mule. He found tubules of greatly reduced diameter, comparable to those seen in sexually immature stallions. He reports excessive numbers of Sertoli cells, many degenerative, as well as degenerative spermatogonia. He also notes the presence of white leucocytes within the tubules, which, to his mind, play a part in the degenerative processes going on there. These obser-

[1] For an account of the production of zebra hybrids see "The Grevy Zebra as a Domestic Animal," by George M. Rommell. *American Breeders' Magazine;* Vol. IV, No. 3, pp. 129–139, November, 1913.

vations are in line with those of Guyer ('00) on sterile hybrid pigeons. Iwanoff further reports abundant parenchyma and interstitial cells, and emphasizes the secretory nature of these tissues, holding them accountable for the secondary sex characters of the mules.

Whitehead ('08) also reports work on testis structure in mules. He found no secondary spermatocytes and no spermatozoa of any kind; interstitial cells were abundant and granular. Whitehead had examined the testes of cryptorchid horses and found them to be similar in structure to those of the mule. He puts the scrotal testis of the mule in the same category with the abdominal testis in cryptorchids of pure species. Sexual passion is quite apart from sexual fruitfulness, mules and cryptorchids exhibiting the former in marked degree. Like Iwanoff, Whitehead says that sexual passion is due to specific internal secretions of the interstitial cells. "They are the only cells which can elaborate it for the only other secretory cells are degenerate, while the interstitial cells are hypertrophied."[2]

The most recent, and detailed work on the structure of the mule testis is by Wodsedalek ('16). He has carefully followed the cell cycle in the mule testis, and, carrying out the suggestions of Guyer made for pigeons in 1900, has offered a specific explanation for the abnormalities seen in the testis, which result in sterility. Wodsedalek had previously reported ('14) thirty-eight as the chromosome number in the mare—each ovum carrying the haploid number nineteen. From his study the above author concludes that a plausible chromosome number for the jack (male ass) is much greater than the horse, namely sixty-five, each sperm carrying thirty-two or thirty-three. As a consequence the fertilized egg destined to produce a male mule shows fifty-one chromosomes, nineteen from the mare and thirty-two from the jack. (It is assumed that the female mule would show fifty-two.) Despite the great diversity in the nature and number of the chromosomes contributed by the ovum of the mare on the one hand, and sperm of the jack on the other, mitosis and cleavage processes are apparently undisturbed, for growth and development of the fetus and of the foal proceed normally.

CAUSE OF STERILITY

As far as can be seen there is nothing irregular in the growth or cell divisions of the mule till he reaches sexual maturity. Up to this time maternal and paternal chromosomes have lain side by side and carried on their customary functions. There has been no necessity for them to cooperate to any noticeable extent, each chromosome has divided at mitosis independent of the others, one-half going to each daughter cell. The real conflict ensues during the various stages of the primary spermatocyte. Normally at this stage there is a pairing and subsequent separation of homologous chromosomes from father and mother. In case of the mule, however, because the ovum and sperm contributed such unequal numbers of chromosomes, there are many chromosomes without a homologue with which to mate, and even in case of homologues the physiological incompatibility of the two plasms render the pairing difficult and incomplete, or prevents it entirely. "So great is this disturbance that the destruction of each cell is inevitable and no spermatozoa are produced, causing the hybrid to be sterile." It is plain that the evidence drawn from such studies makes the likelihood of these animals begetting offspring extremely small if not altogether negligible.

However, it would seem wise to be conservative and tolerant. Several cases have been reported where there is a regular and orderly disappearance of sperm-forming cells. For instance, Morgan has shown that in certain generations of Phylloxerans, in spermatogenesis, half the spermatids (those lacking the accessory chromosome) regularly degenerate. The disappearance of these cells is precise in nature, and occurs in an orderly fashion at a fixed stage in the cycle of divisions. Apparently, how-

[2] Miss Boring (*Biol. Bull.*, XXIII, pp. 141–153), working on the testis of the fowl, failed to find evidence in support of the view that interstitial tissue is responsible for secondary sex characters.

ever, the abnormalities seen in the cell divisions in the mule testis are not precise in nature, but occur in a haphazard fashion, as a result of a tangled confusion of cell elements—it is not inconceivable that a chance series of divisions might give rise to a germ cell able to cause conception in a fertile female.

Moreover, it must be noted that it is extremely seldom indeed that male mules are allowed to come to the age of maturity without castration, and it is even more seldom that they are allowed to breed mares. Therefore there is very slight opportunity to put their breeding powers to a test.

It should be further remembered that in practically every case these microscopic studies have been made on the germ gland of the male. It is conceivable that matters might occasionally proceed differently in the ovary, where a different chromosome constellation exists. This would result in a condition where female mules might at rare intervals possess generative powers but males never.

There may be some uses for which a mule that is only ¼ horse might prove valuable, and certain it is that there are many occasions where a mule that is only ¼ ass would be welcomed with relief and joy. But such animals are not as yet staple market commodities, for whatever the true situation in regard to mules occasionally producing offspring may be, one thing remains certain, namely, that as far as the breeding industry is concerned, we must as yet take our mules half-and-half in the way that Homer and Varro described several thousand years ago.

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IRIS BREEDING

IRISES have been little used by students of genetics, probably because other plants can be grown in less space and time. Pollinations are easily made, however, and any amateur of this genus might well try his hand at crossing some of his favorite forms. Miss Grace Sturtevant of Wellesley Farms, Mass., contributes the following suggestions of technique:

"The irises with which I have worked have been the hardy varieties which could be grown without protection or especial treatment in my garden; thus limiting the scope of the crossing in a large degree to what are known as German irises, though truth to tell I have yet to obtain a seed from a real German iris.

"The method of procedure is simple. I remove the stamens from the bloom to be cross-fertilized, before the pollen sacs open, and apply pollen to the lip of the stigma by rubbing it with a pollen-laden anther from the bloom used in making the cross. This covers the surface with pollen so well that there is little danger from other pollen, but to make matters sure the bloom can be protected for a short time, or the falls removed so that no wandering bee can crawl in beneath the arching style-arm. I usually remove the rest of the buds on that branch and label it.

"On ripening, the seeds are removed from the pod, described, recorded and dried. I have the seed-bed prepared quite a time in advance so as to have it moderately firm; a plan is made, and the seed is planted about half an inch deep; the result of each cross in its respective square; and a square of wire mosquito netting is pinned down over it to protect it from accidental disturbances by birds or animals, as this is in August and the seed does not germinate, as a rule, before the following April. When about an inch high they are transplanted to a bed for seedlings, being placed one foot apart in the lines. Each is recorded on the plan of this bed and here they remain until they bloom. They require little attention (weeding and a few inches of leaves for covering in the fall) until the following year when many will bloom and the descriptions have to be written and records completed.

"Fortunately any gaps in these descriptions may be filled, or additional information as to interesting points may be obtained, in subsequent years. Comparison can also be made with the parents, or offspring, when plants are mature, as records are kept of their permanent positions.

"Although I have not grown enough generations to be able to foretell results, I have obtained some unique individuals; some as good as or better than their parents; and many similar to the well-known garden forms."

Miss Sturtevant's irises show abundant evidence of segregation of characters, and it is therefore fair to suppose that Mendelian heredity would be found in the German irises, if they were properly studied. Such does not seem to be the case in hybrids between wholly distinct species, however.

For many years it has been an open question whether the Mendelian type of heredity applied to crosses between distinct species, or only to crosses within a species, or between hybrid forms. To throw light on this point, W. R. Dykes made a number of hybridizations, and describes the result in the Gardeners' Chronicle of London (Vol. LVIII, pp. 196–197). With numerous pairs of characters, the results showed no dominance but only blending.

Iris boissieri, bulbous, with the beard of the sepals in the form of long straggling golden hairs 0.117 to 0.234 inch in length, crossed with *I. tingitana* having no trace of hair gave a hybrid with hair distinctly visible to the naked eye but less than 0.0585 inch in length.

I. tectorum (which has a tuft in place of hair) crossed with *I. cengialtii* (a hairy type) gave a hybrid with a light violet coloured tuft bearing a short hair.

I. xiphium (without perianth tube) crossed with *I. tingitana* and *I. filifolia* (having perianth tubes 0.975 and 0.507 inch, respectively) gave hybrids with perianth tubes respectively 0.507 and 0.234 inch long.

I. clarkei with solid stems crossed with *I. chrysographes* with the internal cavity of the stem occupying about half the diameter, gave a hybrid intermediate with central hollow almost but not entirely closed with pith.

I. pallida with papery spathes which become entirely white and dry before protruding from the floral opening, crossed with *I. variegata* with green and herbaceous spathes gave a hybrid with spathes green in the lower portion and parchment-like in the upper portion.

The hybrid between *I. reticulata* and *I. bakeriana* is intermediate between the parents as regards leaf shape.

Also with regard to the coloring of the petals many hybrids are intermediate between the parents of various species, *e. g.*, *I. pallida* × *I. variegata; I. trojan*×*I. variegata; I. boissieri* ×*I. juncea; I. fulva* × *I. foliosa; I. forresti* × *I. sibirica.*

With the exception of *I. chrysographes* × *I. forrestii* and also possibly of *I. pallida*×*I. variegata* and of *I. fulva*×*I. foliosa* all the above hybrids were sterile both with respect to their own pollen and that of both parents. The two possible exceptions are cases in which the parents are somewhat related whilst the fertile hybrid has more definitely related parents.

Another interesting species-cross, which to some extent confirms the above conclusions, is reported by S. Mottet in the *Revue Horticole* of Paris (87, pp. 582–583). *Iris pumila*, a species which flowers early (beginning to end of April) with *I. germanica*, of which the earliest flowers appear about the middle of May, yielded numerous varieties flowering in the first half of May, thus enabling growers to have a continuous supply of iris for about three months. Mottet has given the new forms the horticultural name of *Iris interregna* and describes them as intermediate between the two parent species not only in date of flowering but for height, leaves and dimensions of the flowers. Miss Sturtevant adds that interregna flowers are often larger than those of either parent.

IS THE HYBRID ORIGIN O

THE Loganberry, one of the most popular members of the genus Rubus, came to light about 1881, in the grounds of Judge J. H. Logan of Santa Cruz, Cal. It was described by him as a natural hybrid which appeared spontaneously, and he believed that the parents were the Aughinbaugh (a variety of *Rubus vitifolius*, the wild blackberry of California) and a red raspberry, probably the variety Red Antwerp, since these two were growing near together in his yard. The fruit of the Loganberry is, in many respects, intermediate between the blackberry and red raspberry, and Judge Logan's account of its origin was accepted as probable. It has since then been universally described as a chance natural hybrid.

In later years, numerous artificial hybrids between blackberries and red raspberries were secured, Primus and Phenomenal being the best known ones. These were in many respects similar to the Loganberry, and supported a belief that the latter was a hybrid of similar nature.

But evidence which is now accumulating indicates that this belief is wrong. The question is squarely put by W. O. Backhouse, Economic Botanist to the Argentine Government, who writes to this association from Buenos Aires under date of July 4, 1916, as follows:

A BOX OF LOGANB

Although its flavor is too acid for some palates, the Loganb
and raspberry genus. Unfortunately it can only be grow
this area it is so much in demand that many growers hav
taken by canners. The Loganberry has hitherto been
Argentine Government, declares this is a mistake, and N
from the Fancher Creek Nurseries, Fresno, Cal. (Fig. 1

MR. BACKHOUSE'S WORK

"In a footnote to the article of Miss L. M. Standish, on Crataegus (JOURNAL OF HEREDITY, June, 1916), it is stated that the evidence as to whether the Loganberry breeds true is conflicting. The material at the disposal of the present writer is somewhat scattered and not enough to form the basis of a serious scientific contribution, nevertheless the following observations may shed some light upon the subject whether the Loganberry is a hybrid at all.

"The writer has raised Loganberry from seed in some quantity; so also have

IE LOGANBERRY A MYTH?

ATURAL SIZE

e to be considered one of the best fruits of the blackberry
d area of the United States, where there is little frost. In
for the sale of their fruit five years ahead, most of it being
a natural hybrid, but W. O. Backhouse, botanist of the
an students seem inclined to agree with him. Photograph

Messrs. Laxton Bros., of Bedford, England, whose plants he has had the pleasure of inspecting. To say that the Loganberry breeds true is not strictly correct, nor is it correct to say that any real gametic splitting takes place. The plants are nearly all different one from another, but the differences are in minor characters, such as the length of the fruit, the amount of spines on the petiole and leaf and the color of the leaves. From an economic standpoint some are decidedly better than others; but there is no suggestion of either blackberry or raspberry.

"Supposing that the Loganberry were a hybrid, but that it reproduced itself asexually, after the manner of many plants, through the seeds, then one would not expect any variation at all, but all the seedlings should resemble the parent and one another. To test this, crosses were made with other species of the same genus.[1] If the foreign pollen should act simply as a stimulus to make the plant reproduce itself asexually we should expect that there would result Loganberries, exactly like the parent; if proper fertilization should take place we should expect a great diversity of forms, corresponding to the segregation of the various characters in the supposed hybrid, Loganberry.

"What actually happened was that the hybrids were remarkably constant, giving forms which were, looked upon broadly, intermediate between the Loganberry and the other parent chosen. Hybrids between Loganberry and raspberry gave a first generation varying in fertility between almost complete sterility and setting a dozen or so drupels on a fruit; but in vegetative characters remarkably constant and roughly speaking intermediate between the two parents.

"Reciprocal crosses have been made by Messrs. Laxton Bros. with other species, all giving hybrids more or less sterile, but uniform, in each case and

showing nothing to lead one to suppose that the Loganberry was other than a good species.

"Finally, in 1910, the writer succeeded in obtaining a hybrid between the Loganberry and the common English blackberry, *Rubus ulmaefolius*. This proved to be the most fertile of all the hybrids made, setting almost complete fruits when left to natural pollinating agencies and setting fairly well when isolated. The F_1 is, again, more or less intermediate. The down on the fruit is a clean dominant, coming from the Loganberry; the taste is a peculiar mixture of Loganberry and blackberry — it is interesting to note here that the flavor of the Loganberry, which was regarded as a hybrid flavor, is almost a dominant. The color of the fruit is almost black and the shape not quite so long as that of the Loganberry.

"A second generation of this cross has been grown in Buenos Aires giving the very segregation expected, namely, an almost imperceptible gradation between plants which would pass for *Rubus ulmaefolius*, and others which would almost pass for Loganberry. Here again it must be noted that there are no plants which approach the raspberry. Unfortunately, all which have fruited so far have been nearly sterile. This is probably because, in the hot, dry summer of Buenos Aires, *Rubus ulmaefolius* does not fruit.

"From these scattered observations it will be seen that the Loganberry has behaved throughout as a good species, neither breeding perfectly true from seed, nor yet showing more variation than was to be expected in a species. Used either as a seed parent, or a pollen parent, it gave, when crossed with wild species, very uniform hybrids, and some variation when used with cultivated varieties, which are not genetically pure.

"It therefore seems that, unless we can conceive of a hybrid which has resulted gametically pure in the first generation, we must reject the commonly accepted idea of the origin of the Loganberry."

The fact that the Loganberry sometimes, at least, breeds true from seed has been long known. Dr. L. Trabut, botanist of the Government of Algeria, stated to the writer in 1913 that he had been growing it from American seed and that it came true. Similar results have been secured on the Pacific coast; at other times, considerable variation has been observed, although the writer has seen no record of any such amount of variation as would be expected of a hybrid in its F_2 generation.

In order to get the opinions of some American students of the genus Rubus, the editor wrote to U. P. Hedrick, of the New York (Geneva) experiment station, and to C. I. Lewis, of the Oregon experiment station. Mr. Hedrick replied that he had had no personal experience with the Loganberry but that a number of things had recently led him to suspect that it is not a hybrid, but a true species.

Mr. Lewis wrote that he was undertaking an extensive experimental test and in advance of the completion of this could not make a full statement. He expressed his own belief, which he said was now that of most of the workers on the Pacific coast, that the commonly accepted story of the hybrid origin of the Loganberry is not correct, but that it is a true species, as good as plenty of other species in the genus Rubus which, as is well known, is much confused and, due to natural hybridity or some other cause, is highly variable.

If the Loganberry is a good species, it must have a habitat somewhere, aside from Judge Logan's back yard. Why is it that it has never been reported elsewhere?

Mr. Lewis thinks it has been reported, and that there are records of its sporadic occurrence in various parts of California, Oregon and Washington. It may be a species of comparatively recent origin, as its variability suggests. The Oregon station is gathering a collection, and will undertake by breeding to arrive at the real origin of the Loganberry. Evidence will probably be available within a few years, and it looks now as if this evidence would pretty definitely destroy the present belief in the natural cross between a blackberry and red raspberry. It is more probable, as

Mr. Lewis says, that the Loganberry is a dewberry type and a distinct species in itself.

Mr. Lewis was particularly asked about his statement (in Bailey's Standard Cyclopedia of Horticulture) that Loganberry seedlings showed much variation. "What I meant by that," he replies,[2] "was that they vary more than the seedlings of the raspberry."

MUCH CROSSING PROBABLE

"You go into almost any Loganberry patch of any size here in the Northwest," he continues, "and you will find that there is some variation. Perhaps you will find a plant with the Loganberry leaves, but the fruit will be more like the blackberry. . . . It is not uncommon to go into a single half acre of ground and find the cultivated dewberry, the wild native dewberry, the Himalaya, the Evergreen, and perhaps a standard blackberry, such as the Snyder, all growing side by side, and in addition to this, raspberries, perhaps Phenomenal, and others. Now you have there ideal opportunities for crossing, and with a form like the Loganberry, which is perhaps not as entirely fixed as the older forms, I would look for considerable hybridizing to take place."

J. A. Brixby, a nurseryman at McMinnville, "has a very fine collection of Loganberries. He says his seedlings were simply gathered at random but were gathered in a patch where there was quite a wide planting of small fruits, so that probably there were ideal conditions for cross-pollination. His Loganberries show quite a variation in foliage and he tells me that there is a great range in time of ripening and also in acidity, and some change of form."

"Prof. Gardner at one time visited Vancouver Island and while there met a nurseryman in the north end of the island. This man said the Loganberry grew wild in certain portions of Vancouver Island and that he had been in the habit for many years of going to the woods and digging up plants to fill orders whenever his stock was depleted, and he could not see that there was any difference in the wild plants from those he propagated himself. Here in Oregon wild plants of the Loganberry type are found. There are two such plants near Corvallis. . . . I have come across one plant, the owner of which tells me that one half is like the true Loganberry and the other half more like the fruit of the blackberry."

It is evident, then, that American students have been gradually accumulating data which tended to cast a doubt on the paternity of the Loganberry; but the Argentine botanist appears to be entitled to credit as the first man publicly to challenge it. In a genus so confused as Rubus, it may prove difficult to establish the exact origin of the Loganberry, but the evidence now at hand seems to be enough to class as a myth the accepted story that its sole origin was as a spontaneous hybrid in Santa Cruz.

Heredity in Pellagra

The Eugenics Record Office announces the forthcoming publication of Bulletin No. 16 on Pellagra, by C. B. Davenport and Elizabeth B. Muncey. Dr. Muncey worked on the subject in Spartanburg County, S. C., and concludes that "the data collected show no evidence of direct heredity. There may, however, be an inherited predisposition to the disease in those families in which chronic gastro-intestinal symptoms have existed for several generations. With this predisposition to the disease direct contact or life in endemic sections might be the exciting factor necessary for its development."

[1] Mr. Backhouse writes: "I have not defined the different species used in making hybrids with the Loganberry, in my own work, because I am not absolutely sure of the nomenclature; I have no means of verifying it here and do not want to lead people astray; and I cannot divulge those used by Laxton Bros. because they are in the nature of commercial secrets. This, however, does not in any way affect the substance of the communication, the point being that whatever species was used, each gave its own *uniform* batch of hybrids, which is not at all in keeping with the Loganberry's supposed origin."

[2] In a letter dated August 17, 1916.

LOBED LEAVES IN MAIZE

Two Edges of Leaf Cut Each Other When Growing—Resultant Clefts Were Supposed by Blaringhem to be Due to Inheritance of a Mutilation

J. H. Kempton

Bureau of Plant Industry, Washington, D. C.

IN 1911 there appeared in an early variety of maize from Russia what was thought to be a new abnormality. This was a pronounced lobing of the leaves on many of the plants, and as none of the grasses normally has lobed leaves, this character received careful attention.

As the season progressed, the abnormality was found in varying degrees on all of ninety varieties planted that season at Lanham, Md. The conspicuous nature of the lobes led to the belief that this must be their first appearance. This view was quickly dispelled when upon examining commercial plantings of local varieties many of the plants were found to have lobed leaves. In following seasons lobes recurred not only in Maryland, but in many other localities where opportunity for examination was presented. They were also found on plants of Euchlaena, Coix, Tripsacum and various members of the Andropogoneæ, and doubtless occur on many other grasses.

The superficial resemblance of lobes to torn leaves must account for the fact that they had escaped detection in previous years. Careful observation, however, reveals pronounced differences between lobed and split leaves, and once these are recognized, there can be no confusion of the two forms of injury.

The lobes are usually paired, one on each side of the leaf and nearly opposite. This is not always the case, however, as several leaves with only one lobe have been found and a few with as many as six lobes.

The most constant characteristics of true lobes are the margins, which are transparent like those of a normal leaf, and are beset with long brittle hairs and a double row of short saw-like teeth directed toward the apex of the leaf. The edges of torn leaves lack these teeth and the marginal cells are dead. Lobes are also sometimes spatulate in form, with the margin at the base of the split thickened and rounded.

The veins frequently divide a short distance below the split, one branch continuing to the main blade, the other to the lobe. The veins that do not divide alter their course below the split, making a curve which enables them to reach the lobe. The presence of normal marginal tissue, together with the blunt or spatulate form of many of the lobes, indicates that the formation of the lobes takes place at a very early stage in the development of the leaf.

The lobing often results in a complete entanglement of the leaves, so that the plant is prevented from growing in a normal manner and in extreme cases the upper leaves and tassel never emerge. Plants thus affected have a characteristic "bent over" shape.

LOBING OF OTHER ORGANS

The occurrence of lobing is not confined to the leaf blades of the main culm and tillers, but has also been frequently observed on other homologous organs of the plant. The most common among these are the husks, husk leaves, and the glumes of the tassel. In this latter case the lobes are very small, but are undoubtedly of the same nature as those on the leaf blades.

A slightly modified type of lobing is also found on prophylla. The abnormality in this case could hardly be called lobing, but is in reality notching. These notches are in pairs on opposite sides of the prophylla, much the same as the lobes on the blades.

Lobes approximating in shape those

THE "LOBES" OF MAIZE LEAVES

The edges of the leaf sometimes cut each other as they grow, thus producing this deceptive appearance of lobing. The veins of the leaf rearrange themselves, as may be seen in the lower left-hand corner of the picture, to conform to the changed condition of affairs. This abnormality is not very rare, although it has seldom been noticed. Blaringhem, who mutilated maize plants to see if he could produce an inherited effect, found these "lobes" in the progeny, and wrongly supposed that they were due to his manipulations. Photograph natural size. (Fig. 11.)

on the leaves are occasionally found on the keels of prophylla, though they are usually small and poorly formed.

It was at first thought that the lobing of the leaves was a purely local abnormality directly due to some climatic disturbance much as is the leaf cut or Tomosis of Cotton. However, the observations of Blaringhem in France and Gernert in Illinois demonstrate beyond doubt that forms of lobing have a wide distribution.[1] Investigation also shows that lobing not only occurs on experimental varieties outside their natural environment, but is found in about the same percentage in commercial plantings in many localities.

The cause of the lobing was not fully understood until in dissecting some very small lateral branches of Euchlaena it was noticed that several of the shoots were prevented from unfurling by having the margins of one of the leaf blades firmly held together with lobes. By examining still smaller shoots, the stage was finally reached where the lobes were just being formed. These shoots were about 6 cm. long and the tissue was exceedingly tender. It was at once seen that the lobes were formed by the margins of the leaf blades cutting each other where they crossed in unfurling.

The forcing of the inside margin of the leaf against the outside margin results in the inside margin being cut, but at the same time the outside margin also receives a slight cut through which the lobe on the inside margin grows. As this lobe grows it cuts upward into the outside margin which accounts for the small back cut sometimes found on one margin of the more perfect specimens. A slight rupture of the tissue, which at this young stage is extremely tender, results in the separated cells developing practically independent of the remainder of the leaf blade.

The fact that the two margins of the same leaf mutually rupture each other accounts for the lobes being most often found in pairs one on each side of the leaf.

Lobes are not always made by the margins of the same leaf, but are sometimes made by the margins of adjoining leaves. In this way a single lobe on only one side of the leaf is brought about. Frequently when the margin of a leaf comes in contact with another leaf immediately inside of it the result is an opening in the leaf which develops marginal tissue on each edge. The marginal teeth, if examined at an early stage, are seen to be about half the size of the teeth on the outside margins of the blade.

The comparatively late stage in the development of the leaf at which lobing takes place, demonstrates that the cells normally forming the body of the leaf blade are capable of being transformed into the specialized marginal tissue.

Mutations in the Potato

It has sometimes been alleged that the characters of wild species of potato are immutable, but J. Aumiot, who has been breeding many of them, reports changes of many kinds, in *C. R. Acad. Agric.*, November, 1915, summarized in the *International Review of Agriculture.* Aside from changes of simple characters like color, there were supposed mutations which affected the time of maturity, the character of the skin, the growth habit, and the flowers. In one instance a plant of *Solanum commersoni* is alleged to have been transformed so that it closely resembled a cultivated variety. The study of such cases as this might throw much light on the process of evolution.

[1] The first notice of these lobed leaves which I have found is by L. Blaringhem in *Mutation et Traumatismes* (Paris, 1908). Blaringhem mutilated maize plants in various ways and then grew their seed; the resulting plants showed various abnormalities, such as cleft leaves, which he thought were due to his mutilation of the parents. When other observers discovered the same abnormalities in maize plants whose parents had not been mutilated, Blaringhem's effort to revive the inheritance of acquired characters came to nothing. Since then Gernert mentioned lobed or cleft leaves as one of the many abnormalities to be found in maize, but gave no explanation of their origin. ("The Analysis of Characters in Corn and their Behavior in Transmission," p. 25, Champaign, Ill., 1912.)

HAND AND FOOT PRINTS

Corrugated Skin of Palm and Sole Furnishes Many Interesting Problems -Limits of Heredity in Finger-Print Patterns—The Friction-Skin Patterns of Monkeys and Apes

FINGER-PRINTS are naturally associated in one's mind with criminals; but the possession of a complicated pattern on the "friction-skin" of the hands and feet is by no means confined to the ladies and gentlemen of the Rogues' Gallery. Not only do all human beings possess such friction-skin, but the anthropoid apes have quite similar patterns, which can be followed down to their rudiments in the lower monkeys, and traced in many other animals.

Certainly those geneticists who announce the futility of looking for a "purpose" in anything save themselves a lot of trouble; for a long debate has been carried on over the possible use of these palm and sole patterns. Galton tells[1] a good story of Herbert Spencer in this connection.

"An amusing instance of his strong leaning to *a priori* reasoning rather than to experiment occurred on his coming to a laboratory I had then established for anthropological purposes. I told Spencer of the difficulty of accounting for the peculiarities in the pattern of finger-prints, and that the dissection of embryos had thus far told no more than that they could be referred to folds of membrane in which the sudorific glands were formed, but threw no light on the reason why the pattern should here be a whorl and there a loop and so on. He said that dissection was not the best way to find out what I wanted to know; I ought to have started from a consideration of the use of the ridges, and he proceeded to elaborate a line of argument with great fulness in his usual sententious way. It was to the effect that the mouths of the ducts, being delicate and liable to injury from abrasion, required the shield of ridges, and on this basis he reared a wonderfully ingenious and complicated superstructure of imaginary results to which I listened with infinite inward amusement. When he had quite concluded, I replied with much humility, that his arguments were most beautiful and cogent and fully deserved to be true, but unfortunately the ducts did *not* open out in the shielded valleys, but along the exposed crests of the ridges. He burst out with a good-humored laugh, and then told me the story, which also appears in his Autobiography, of Huxley's saying that if Spencer ever wrote a tragedy, the plot would be the slaying of a beautiful induction by an ugly fact."

ORIGIN OF THE RIDGES

Later students, while proceeding from sounder premises than Spencer, have been equally obliged to depend on speculation. Miss Whipple, who studied the genesis of the ridges which characterize friction-skin in various orders of mammals, showed[2] that "they are formed from either (1) the coalescence of separate *epidermic units*, each with a sweat gland (and typically, a sebaceous gland and a hair) which arrange themselves in rows and form single ridges; or in other cases from (2) *epidermic rings*, formed by a coalescence of the primary units in circles, which, by becoming elliptical and arranging themselves in rows corresponding to their longitudinal axes, form simultaneously two rows of ridges."

It is now affirmed that the sweat glands open on the crests of the ridges in order that their openings may not be clogged up. As to the function of

[1] In Duncan's biography of Spencer (New York, 1908), Vol. ii, pp. 263–264.

[2] Zeitschrift f. Morphologie u. Anthropologie, Band vii, pp. 261–368. Miss Whipple later became Mrs. Harris H. Wilder.

A HUMAN FINGER-TIP

The palms of the hands and soles of the feet are covered with little ridges or corrugations, which are supposed to be useful in preventing the grasp from slipping; whence the name of friction-skin has been given to these surfaces. The ridges are developed into various patterns; the one above is a loop on the left forefinger. The ridges are studded with the openings of the sweat glands, the elevated position of which is supposed to prevent them from being clogged up; further, the moisture which they secrete perhaps adds to the friction of the skin. Photograph by John Howard Payne. (Fig. 12.)

the ridges themselves, it is suggested that they serve at least two purposes: to give increased delicacy to the sense of touch, and to furnish a surface which will prevent slipping.

Walter Kidd,[3] the chief defender of the tactile theory, points out that if friction were the only use of this corrugated skin, it would hardly be necessary on the sole of man's foot; since prior to the time when he wore shoes his feet were planted on grass and rocks where the slight friction offered would be of little value. He thinks that the pattern on the sole rather increases the tactile sensibility of that region, and aids a man in keeping his balance when he walks. But such theories are not very convincing, particularly as man may be supposed to have inherited his sole-pattern from ape-like ancestors whose feet were adapted to clinging to the boughs of trees.

The idea that this skin is, as Wilder

[3] The Sense of Touch in Mammals and Birds. London, 1907. Galton also accepted this theory, to some extent. It is true that the finger tips are especially sensitive, but the nature of relation between this sensitiveness and the ridges is not proved. The skin is a mosaic of tiny sensorial areas, touch spots, cold spots, warm spots and pain spots being widely and irregularly distributed. On the finger tips the touch corpuscles are frequent—about twenty-one per square centimeter on the index finger, while there are only two to eight per square centimeter on other parts of palm and on the sole.

SIXTY-FIVE POINTS OF IDENTIFICATION

Print of a finger-tip showing a loop-pattern, enlarged about eight times. This is a common type of pattern, and at first glance the reader may think it could be mistaken for one of his own. There are, however, at least sixty-five "ridge characteristics" on the above print, which an expert would recognize and would use for the purpose of identification. If it were found that the first two or three of them noted corresponded to similar characteristics on another print, the expert would have no doubt that the two prints were made by the same finger. In police bureaus, finger-prints are filed for reference with a classification based on the type of pattern, number of ridges between two given points, etc; and a simple formula results which makes it easy to find all prints which bear a general resemblance to each other. The exact identity or lack of it is then determined by a comparison of such *minutiae* as the sixty-five above enumerated. While the general outline of a pattern is inherited, these small characters do not seem to be, but are apparently rather due to the stretching of the skin as it grows. Illustration from J. H. Taylor. (Fig. 13.)

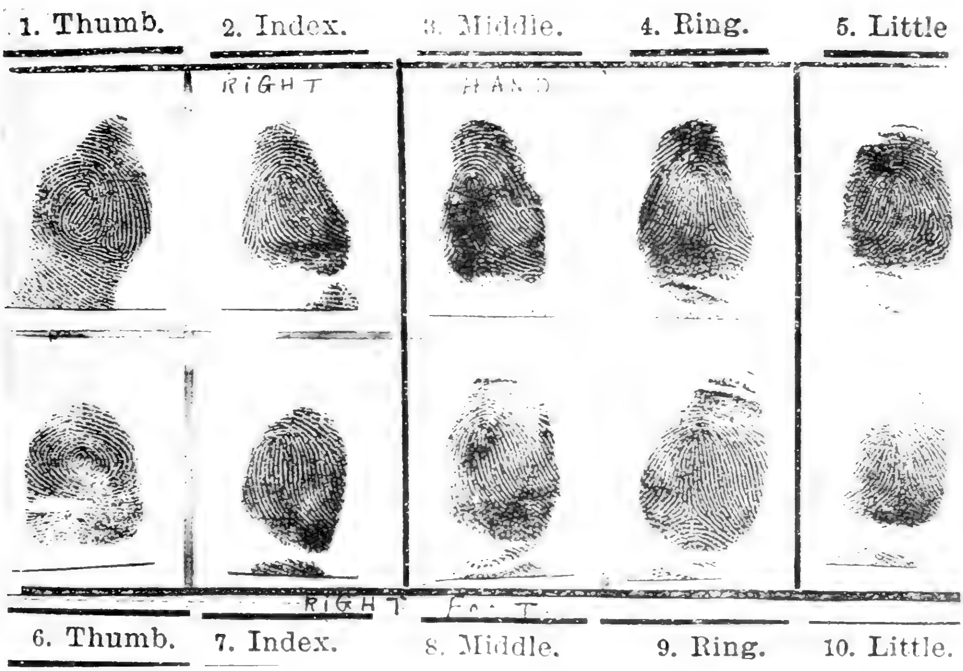
and Miss Whipple named it, really a friction-skin is much more plausible. Says Lydekker:[4]

"The best clue to the problem seems to be afforded, somewhat strangely, by the tails of such South American monkeys as are endowed with prehensile power in those appendages; confirmatory evidence being afforded by the prehensile tails of the American opossums and tree-porcupines, as well as by those of the Australian phalangers. In all these animals the naked, grasping portion of the tail, which is situated at the extremity, is covered with papillary ridges and grooves precisely similar to those on the hands and feet of monkeys, but invariably arranged in

[4] Mostly Mammals, by R. Lydekker. London, 1903, pp. 145–155.

RIGHT FOOT OF A LEMUR

In this low form of monkey the friction-skin is well developed, but the patterns which characterize the higher apes and man have not yet appeared. In the place of the well-known loops, arches and whorls, the lemur's finger-tips are seen to be marked only by longitudinal ridges. Photograph by Gertrude Sullender. (Fig. 14.)



FINGER AND TOE PRINTS OF AN ORANG OUTANG

If the reader will compare these prints with the tips of his own fingers, he will see that they are not very dissimilar; he will also find on inspection, what he has possibly never before noticed, that his own toes have equally distinct and well-marked patterns. Most of the patterns are common both to man and his humble kin, and no one but an expert, seeing one of the above prints, could declare that it had not been made by a human being. The study of friction-skin furnishes, among other things, good evidence in support of the doctrine of evolution. Photograph by Gertrude M. Sullender. (Fig. 15.)

simple transverse lines around the tail, so that in the act of grasping they would be parallel to the long axis of the branch around which the tail was coiled. Clearly, then, papillary ridges are primarily connected with the grasping power, and when they are intended solely for that function, they are so arranged as to be parallel to the axis of the object grasped. As regards this function of the papillary ridges, Dr. Hepburn observes that, although they are comparatively low, 'yet they must cause a certain amount of friction, and thereby prevent slipping, while the naturally moist and clammy condition of the palm and sole of monkeys must be of material assistance to the firmness of the grasp. A man instinctively moistens the palms of his hands when he wishes to make his grasp more secure; and the grasping power of monkeys must be considerably increased by the application of the numerous papillary ridges which are capable of intimate adaptation to the surface of the object grasped.' "

DARWINIAN SPECULATIONS

One may admit that a fully developed friction-skin may be useful, and yet refuse to believe that its origin is due to natural selection. We are asked to believe that the monkey in whose palms a slight transverse corrugation appeared would be less likely to slip from the limb and fall into the jaws of the waiting carnivore below; we are also asked, in explanation of longitudinal ridges in the hand, to believe that a fruit would less often slip from the hand of the monkey in which these first appeared, and therefore he would be the venerable sire of a well-endowed progeny, when

A GORILLA FINGER-PRINT

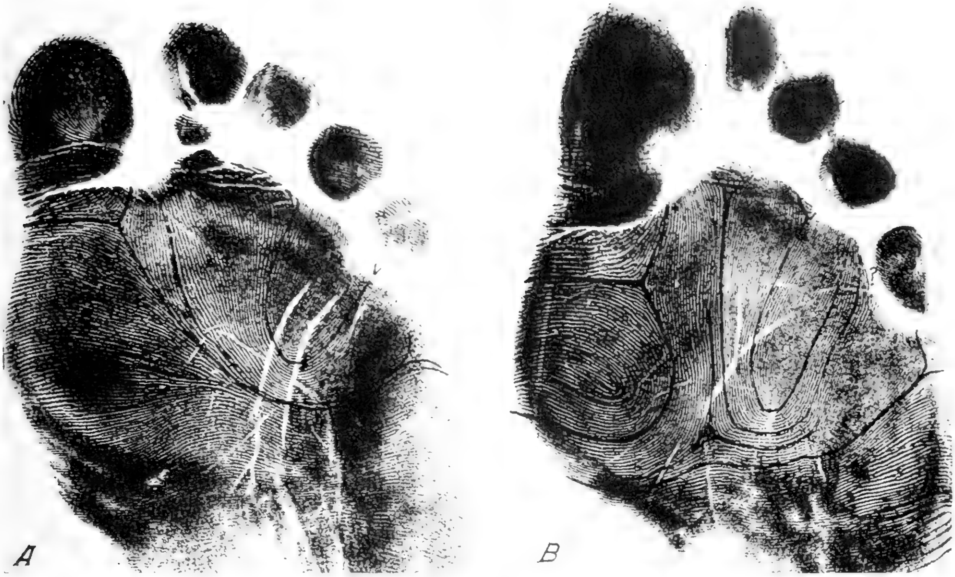
This rolled finger print of the female gorilla "Dinah" in the New York Zoological Garden has been enlarged about three times. As J. H. Taylor, finger-print expert of the Navy, points out, it shows that the ridges in the great apes are quite as perfectly developed as they are in man. Identification experts have found it necessary to make a study of ape's prints, in order that they may be distinguished from those of men in criminal cases. Photograph from René Bache. (Fig. 16.)

all his brothers had starved to death, childless. It may be so, but to believe it requires little less than the religious faith avowed by Tertullian: "*Credo quia absurdum est; credo quia impossibile.*"

Without answering the "why" of origin, but agreeing that the friction-skin now probably serves the purpose suggested in the name, and perhaps other purposes, we may investigate its development in the monkeys and apes.

The lemur, a low form in the scale of evolution, has the foot-print shown in Fig. 14, the patterns of which are decidedly simple as compared with those of man. As we rise higher in the scale, we find the pattern becoming more complicated. The progression is not always what we would expect. Thus the hand of the chimpanzee is more human in form than that of any other ape; yet its palm-pattern is less complicated than that of the orang or gorilla, although more complicated than that of the gibbon, which is commonly held to be the most primitive anthropoid. And in man, whose palm-pattern is highly complex, the sole of the foot has a simpler pattern than that of the orang and gorilla—an evidence, some would say, that friction-skin on man's sole is no longer of use to him.

One distinction made by Lydekker is interesting. "In all the lower monkeys that have been examined by both Dr. Hepburn and myself the pattern of the papillary ridges is of the concentric type, in which the central ridges are longitudinal and the external ones form broad ellipses. In the chimpanzee, however, and probably also in some or all of the other manlike apes, the pattern on the balls of the fingers is of the form known as the looped type, which is of common occurrence in the fingers of the human hand. On the finger-tips of man alone occurs the still more com-



HUMAN FOOT-PRINTS DIFFER AS MUCH AS HAND-PRINTS

The toe and ball of the foot have well marked patterns, but the human heel is usually marked merely by curved lines, just as is the toe of the lemur. One distinct pattern on man's heel has been found, but it is very rare. In the above prints, heavy lines have been added to show the types of pattern. Photograph from René Bache. (Fig. 17.)

plicated whorled type;[5] and it is thus evident that even in such a minute detail as the arrangement of the lines on the fingers the manlike apes and man stand apart from their kindred, and that in man alone is the most complicated type ever developed, although even in him it is comparatively rare."

USE OF APES' FINGER-PRINTS

This similarity between the finger-prints of great apes and man is not without importance from a practical point of view. In the Navy, for example, where pets are universally kept, monkeys are often found. Suppose there is a burglary in the captain's cabin, and blurred finger-prints are discovered. Suspicion might have been directed at a steward; but if it were shown that these finger-prints were not made by a human being, the ship's mascot would be properly blamed. The possibility of this was great enough to lead J. H. Taylor, finger-print expert of the Navy Department of the United State Government, to have prints made from some of the common types of apes and monkeys, which are kept on file for future use, and some of which are reproduced in connection with the present review.[6] Few who have not given careful study to the subject would be able to say that the finger-

[5] J. H. Taylor points out that this is incorrect. The thumbs of the orang reproduced in Fig. 15 show well-developed whorls In complexity of finger-tip pattern, as in many other physical characters, man must take his stand on a level with the other primates—he cannot claim to be in a class by himself. It is also in accord with the remark of Darwin, citing Huxley's work, that "in every visible character man differs less from the higher apes, than these do from the lower members of the same order of primates."

[6] These photographs (Figs 14, 15 and 16) were made on May 8, 1915, by Miss Gertrude M. Sullender, finger-print expert at Blackwell's Island, and Patrick Ryan, of New York City, through the courtesy of Park Commissioner Ward. Fig. 16 is an enlargement made by René Bache. Mr. Taylor notes that "the impression taken from the baboon and monkeys' *feet* would all be

prints of a gorilla, shown in Fig. 16, were not made by a human being.

The problem may arise in connection with more serious crime. Every one knows Edgar Allen Poe's detective story, "The Murders in the Rue Morgue," which turned upon the identification of a great ape as the perpetrator of the mysterious crimes. A somewhat parallel case occured in France only last year. The newspaper account says:

"The victim was a young woman, Mlle. Marie Christophle, aged 24, belonging to an old and wealthy family living at No. 43 Cours Sablon at Clermont-Ferrand, an important French provincial city. The family consisted of this girl, her mother, and a brother, Jean Christophle, one year younger than herself. They enjoyed a large income and lived in a fine old house. The son was called as a soldier on the outbreak of the war, but obtained a comfortable position on the staff, which enabled him to live at home in Clermont-Ferrand.

"Mlle. Christophle occupied a bedroom on the fourth floor of the house. At half-past 2 in the morning agonized shrieks in different tones and cries of 'Fire!' coming from this house were heard by the neighbors. The firemen broke into the house and hurried to Mlle. Christophle's room, where the fire was burning.

"They found that it was already nearly extinguished, and soon put an end to it. Jean Christophle and his mother had apparently been busily engaged in trying to put out the blaze. The big old-fashioned wood four-poster bedstead, with canopy, had been partly burnt up.

"In the midst of the ruins, by the side of the bed, lay the dead body of Marie Christophle. The firemen and others at first assumed that she had been suffocated by the fire.

"In due course a judicial inquiry into her death was begun, and at once the interesting fact was established that her death was not due directly to the fire or to the suffocation caused by it. She had received severe blows on the head from sone blunt instrument probably capable of causing death.

"She had also received injuries in many parts of the body which, it is thought, might have been caused by the hands of a powerful man."

Her mother and brother thought these injuries were due to the top of the bed falling on her, and to her falling on a table and chair; and that death resulted from an attack of heart trouble, to which she was subject.

"I do not believe she was attacked by any one," said her brother. "The first information I had of trouble was when I heard her shrieks and then the noise of her body falling to the floor. Then I rushed to her room. No man who had attacked her could have escaped without passing my room and being seen by me."

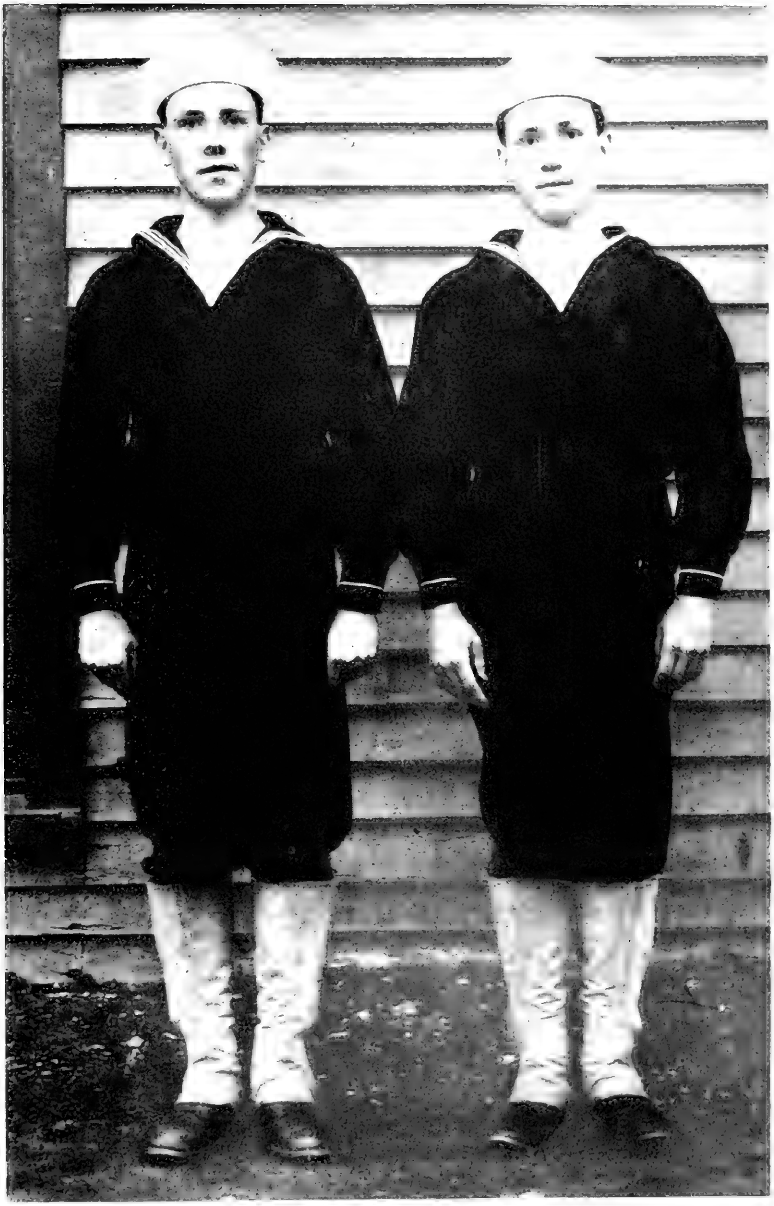
After some weeks, during which the police made no progress, the police arrested Mme. Christophle and her son, on suspicion of causing the girl's death. There was no direct evidence against them.

"Then it became known that the police of Clermont-Ferrand were working on the theory that an ape had committed the mysterious crime. This fact first leaked out when it was learned that the police had been examining all the monkeys in the possession of persons in Clermont-Ferrand.

"This led enterprising reporters to the discovery that the police had kept a remarkable collection of finger-prints found in and about the room where the tragedy occurred and upon the body of the dead girl.

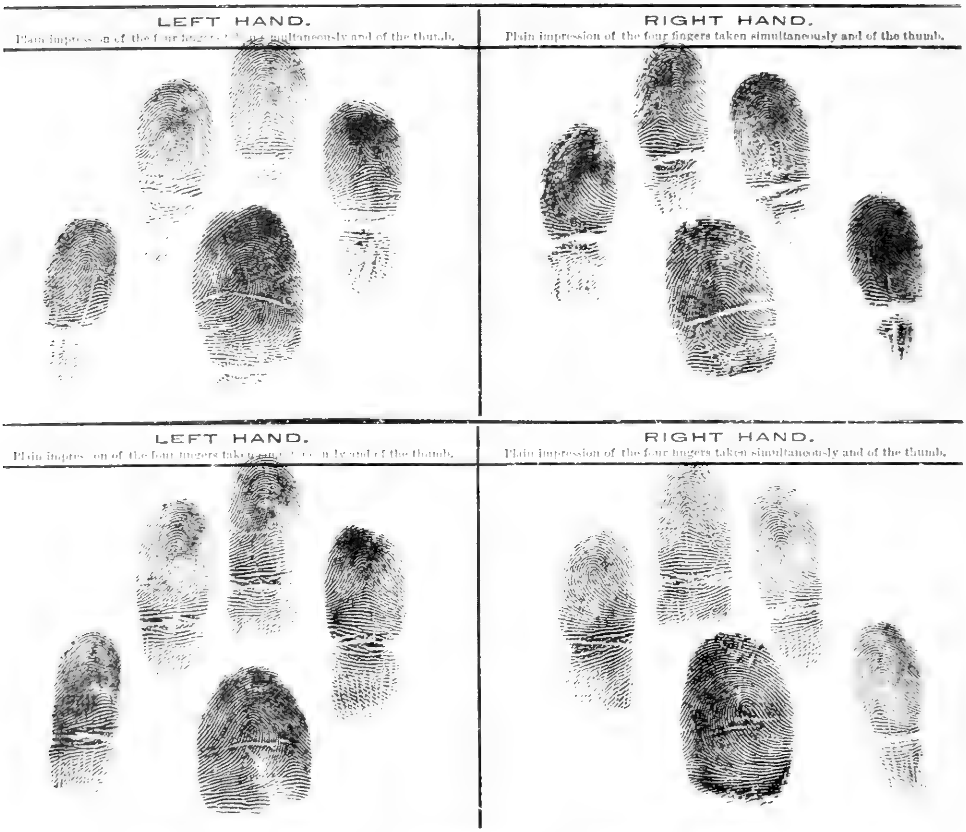
"Some of the injuries on the body of the girl were, it was reported, apparently

classified as almond shaped whorls, but unlike the impressions made by the human hand no deltas are shown, which would prevent a further classification of the impressions by ridge tracing. It seems quite remarkable that in the higher development of the primate family the ridges in the feet should have obtained a development so similar to the ridges in the fingers of a human being, that at a glance you would take the impression to have been made by a hand of a person that had performed much manual labor, while the Lemur shows only a blur without the significant lines."



SUPPOSED "IDENTICAL" TWINS

The only measurable difference between these two young Irishmen is an inch in height; if they are separated few people can tell one from the other. Their commanding officer was obliged to put them in separate companies, and even then did not avoid frequent embarrassments. Their finger prints, as shown in the following illustration, are remarkably similar but not identical: a fact which may be taken to show that heredity governs the main outlines but not all the details of the finger pattern. Photograph from J. H. Taylor. (Fig. 18.)



FINGER-PRINTS OF SUPPOSEDLY "IDENTICAL" TWINS

Above are the finger-prints, supplied by J. H. Taylor of the Navy Department, of the two young sailors shown in Fig. 18. The reader might examine them once or twice without seeing any differences. Systematic comparison reveals that the thumbs of the left hands and the middle fingers of the right hands particularly are distinguishable. Finger-prints as a means of identification were popularized by Sir Francis Galton, the founder of eugenics, and their superiority to all other methods is now generally admitted. In addition to this practical usefulness, they also furnish material for study of the geneticist and zoologist. (Fig 19.)

caused by fingers and thumbs of enormous strength. They were not the fingers and thumbs of young Christophle, and they differed in type from those of any other man preserved in collections of finger-prints. The same finger-prints were found on the back of a chair in the bed-room and upon the window-pane.

"Five monkeys were found by the police in Clermont-Ferrand, but they were all small, and their finger-prints could not possibly have been confused with those of a man.

"It was clear that if one of the simian family was concerned in the tragedy it must have been a great ape, such as an orang outang, a gorilla, or a chimpanzee. If that was so it must have belonged to some wandering showman who had passed through the town. The police are now hunting for such a showman who passed through the town at the time of Mlle. Christophle's death.

"A theory has been put forward that the ape escaped from its house or cage during the night, ran through the empty streets of the town and was attracted by the light in the fourth-story window

of the Christophle house. Then the ape ran up a rain-pipe, reached the window, entered the room, attacked the girl, beat and choked her to death and upset the lamp in the struggle. Finally it escaped in the way it came."

GALTON'S PIONEER WORK

Whatever the outcome of this case, there is no room for doubt about the utility of finger-prints in police administration nowadays. Their use was first systematized and made popular by Sir Francis Galton, who had heard of a primitive form of finger-print registration in Bengal.

After collecting and classifying thousands of prints, Galton reached the conclusion that the chance of two finger-prints being identical is less than 1 in 64,000,000,000, so if the number of human beings alive is reckoned as 1,600,000,000, there is a smaller chance than one in four that the print of a *single* finger of any given person would be exactly like that of the same finger of any other member of the human race. When two fingers are considered, the improbability of identity becomes squared, with three fingers it is cubed, and so on. As police officials usually take all ten fingers, the chance of finding any two sets alike is wholly outside the range of human probability: actually, all possibility of error is eliminated. Galton spent a great deal of time working up a classification of finger-print patterns which would permit them to be indexed and readily referred to; his system, with some improvements by Sir Edward R. Henry of the London Police Department, is now in general use in civilized countries and has proved thoroughly satisfactory.

Emphasis has been given to the impossibility of finding two sets of prints that are identical; this impossibility extends even to the prints of duplicate or so-called identical twins, who might be quite indistinguishable by photograph, by Bertillon measurements, or by any other system of identification that has been devised. Nevertheless the prints of twins of this sort are much more alike than the prints of two persons picked at random, or even of two ordinary brothers—a fact which indicates that the main features of the pattern, at least, are inherited.

J. H. Taylor has furnished the photograph reproduced in Fig. 18 of two young Pennsylvania Irishmen who enlisted in the United States Navy at about the same time and were sent to the same training school. One was 1 inch taller than the other; but when they were not together no one could tell which of the twins he was addressing. The commanding officer was so much worried that he attempted to evade the problem by putting them in separate companies. Their likeness led to troubles which finally resulted in their withdrawal from naval life. Their finger-prints, reproduced in Fig. 19, will probably at first glance be indistinguishable to the reader, but more careful study shows slight differences which would give them different classifications and permit no chance of confusion in the mind of an expert.

INFLUENCE OF HEREDITY

The finger-prints of these twins suggest that heredity largely, but not wholly, determines the pattern. Galton made the first serious study of this point, taking ordinary pairs of brothers. He found there was more often likeness between their finger-prints, than was the case with two individuals taken at random, a fact which indicates hereditary influence.

Since then Dr. Harris H. Wilder, Professor of Zoology at Smith College, Northampton, Mass., has given especial attention to the inheritance of palm and sole patterns. Describing the patterns of duplicate twins, he points out[7] that the general type is usually the same, although there is room for much variation in the details. "It is as though identical forces had directed the development in the two individuals, but that the material had yielded a little unequally to the strain of growth, a given area being a little more expanded

[7] *American Journal of Anatomy*, Vol. iii (1904), pp. 387–472.

and consequently covered by a few more ridges in one than in the other."

"This occasional wide discrepancy in the number of ridges suggests that we are on the border between characteristics which are duplicated [in duplicate twins] and those which are not. While the correspondence between the main lines and areas, the patterns and other figures, and even the number of ridges in most cases is nothing short of remarkable, the law seems to fail at about the latter point, and if we turn to the '*minutiae*' of the ridges,[8] that is, the forkings, interruptions, interpolations and isolations, we find that the limit of resemblance has been passed, and that whatever law of heredity or of construction has caused a similarity of form or arrangement in the larger parts, it is here no longer binding. Perhaps in this way we may be led to approximate the question asked by Galton, 'What is the minutest biological unit transmissible by heredity?', since in individuals that arise from one egg and thus possess, presumably, the same inheritance, the main lines, areas, patterns and other large features are duplicated exactly, or as nearly as the ridges will allow them to be, while the ridges themselves with their minutiae are not."

PRINT OF A SPLIT FINGER

A striking evidence that the minutiae are not due to heredity was discovered by Wilder when he observed a man with six fingers, one of the original five having split in the course of development. The pattern of these two finger-tips, which in origin were halves of the same finger, was not identical.

Given the hereditary basis of finger-patterns, it might be expected that different races would differ in this characteristic. Galton, however, concluded from a study[9] of English, Welsh, Hebrew, Basque and Negro finger prints that "there is no *peculiar* pattern which characterises persons of any of the above races." Prof. Wilder has made an interesting study[10] of negro and white palm and sole prints, and finds that here distinct races have distinct racial formulae, which are characteristic but not invariable. No pattern was found among negroes, which could not be duplicated among whites; yet a certain pattern was more common among negroes and another among whites. Further, there was found much more individual variation among the whites than the negroes, the latter exhibiting only sixteen different patterns, while the whites disclosed forty-four. It is probable that the negro tends to be more primitive in this respect than does the white race.

There appears to be no constant difference between the two sexes in respect of friction-skin patterns, but Ch. Féré believes he has found some differences which are correlated with intelligence. When taking the hand prints of idiots, he found that in many cases their left thumbs were not wholly opposable.[11] He further observed that the most complex forms of finger-print patterns are on those digits which are most differentiated functionally: *i. e.*, the thumb and first finger, and the great toe. Finally he states,[12] but without adequate evidence, that "there is a correlation between the complexity of the patterns of the papillary crests and the development of the intellect and senses."

The problem of working out the exact mode of inheritance of friction-skin patterns appears at present to be almost hopeless; certainly Wilder's hypothesis[13] that they are due to "two or more Mendelian factors" is not yet proved. But the study is full of interest and offers promising results not only to geneticists, but to taxonomists, morphologists and ethnologists, as well as policemen. And as Wilder points out, "Unlike most biological material, that concerned here is readily obtained,

[8] To those engaged in finger-print identification, these *minutiae* are known as "ridge characteristics," and classified as abrupt beginnings and endings of ridges, bifurcations, islands, etc.

[9] Finger-Prints, by Francis Galton. London, 1892, Chapter XII.

[10] *American Anthropologist*, Vol. xv (1912), pp. 189–207.

[11] *Comptes rendus de la Société de Biologie*, Tome 50, p. 827.

[12] *Ibid.*, Tome 48, p. 1115.

[13] *Biological Bulletin*, Vol. xxx, No. 3, March, 1916. There is a good bibliography attached to this paper.

and easily kept, a series of prints being for most purposes more convenient for study than the actual objects; the prints, too, are more accurate records of the facts than any drawings or even photographs." If genealogists would begin recording the finger prints of all the living individuals in their studies, a great deal of valuable material could be accumulated without difficulty.

Mutations in Walnuts

An oak-like mutation which occurred in the California black walnut and led some observers to suppose that a natural hybrid had been produced between oak and walnut, was described in this journal (VI, No. 12, December, 1915) by Prof. E. B. Babcock of the University of California. He has now published further evidence that it is really a mutant, in *U. of C. Pub. in Agric. Sciences*, September 20, 1916 (II, No. 3). Pollen from the oak-like mutant was applied to pistillate flowers of the California walnut; the resultant trees were all normal California walnuts. When this F_1 generation was self-pollinated, twelve trees of *Juglans californica* were secured and six of the var. *quercina*. Prof. Babcock therefore thinks it likely that "the genetic relationship between *californica* and *quercina* is a difference in a single factor of the same Mendelian reaction system." A parallel mutation has been discovered in the Northern California walnut (*Juglans hindsii*).

Hereditary Nomadism and Delinquency

The study of nomadism, recently initiated by C. B. Davenport (see the Journal of Heredity, April, 1916), is continued by J. Harold Williams in the *Journal of Delinquency*, I, 4, 209–233, September, 1916. Dr. Williams publishes charts showing the family history of twenty-four nomadic delinquent boys, and also data about the families of twenty-four non-nomadic delinquents picked at random; and as there is more nomadism in the families of the nomadic boys than in those of the non-nomadic, he concludes that there is basis for the belief that nomadism (expressed often in the form of truancy in his cases) is an inherited trait. Aside from the difficulty of defining the trait, there is a lack of critical cases. There are doubtless some hereditary factors back of nomadism, truancy, and "various kinds of periodic behavior," but the studies so far made do not throw much light on the method of heredity.

A Yellow Sweet Pea

To produce a yellow sweet pea has been for years the ambition of sweet pea breeders, just as rose breeders have longed for a blue rose. The difficulty in each case is that the desired color is not found in the species, and the breeder is not able to secure it by combination with some other species. At the eighth annual meeting of the American Sweet Pea Society, David Burpee expressed doubt as to whether the yellow variety could be secured. If it does come, it probably will be as a result of crossing *Lathyrus odoratus* with some other species. Unfortunately, it does not cross readily; in spite of the efforts of many breeders, it is said that no hybrid has ever been obtained between the sweet pea and any other species even of the same genus.

COOPERATION IN PRODUCTION OF CALIFORNIA GRAPE-FRUIT

PLANT breeding in the past has proceeded mainly through the efforts of individuals. In a few industries it has now become the object of cooperative effort. The latest example is furnished by the grape-fruit growers of California.

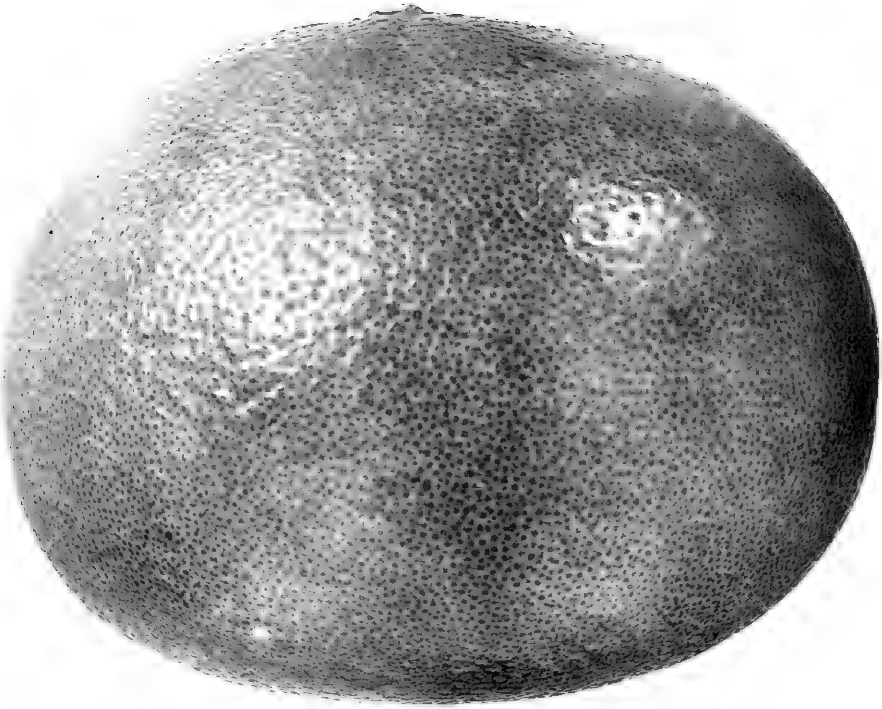
There are, it must be remembered, two methods of procedure in plant breeding: (1) the creation of new varieties; (2) the improvement and standardization of existing varieties. The former is the more spectacular and interesting, and has been much practised by plantsmen, whereas animal breeders of the last generation have limited themselves mainly to perfecting the breeds they now possess. This perfection of existing varieties is no less important in plant breeding, and has been undertaken in an organized way by "The Grapefruit Club."

Most American grapefruit are produced in Florida, the industry in California amounting to only 300 carloads this year. The principal variety grown in California is the Marsh, which originated about thirty years ago in the grove of C. M. Marsh at Lakeland, Fla. He found one tree which produced a smooth, flattened, seedless fruit: its origin is not known, and it may be either a seedling or a bud sport. The tree was killed by the "great freeze" in the winter of 1894-95, just after Mr. Marsh had made plans to propagate it extensively, and had cut about 10,000 buds, which he was storing. He had also grown many seedlings to bud, but most of them were killed. He succeeded, nevertheless, in propagating a number of Marsh trees. In the spring of 1895 a representative of Riverside, Cal., citrus growers was sent to Florida to get new varieties, and succeeded in securing a quantity of Marsh budwood, which formed the first introduction of this variety to California. One of these parent trees is still bearing in Riverside. A number of distinct introductions of the same variety have been made in later years.

In Florida the Marsh is now the favorite variety, although H. H. Hume says it lacks flavor and is surpassed by other varieties. In California there is hardly a question about its superiority; it is generally considered to be a better fruit there than in the place of its origin. The same is true of the Bahia Navel Orange, which, under the name of Washington Navel, is a more attractive fruit in California than in either its Brazilian home or in Florida;[1] and the explanation of this is to be found in the climate. The cold California nights give the fruit a better color than it has in Florida; while the dry, sunny summer results in the production of more sugar, the translocation of which to the fruit is again favored by the sharp drop in temperature at night. The same conditions likewise result in the production of more acid. Cold nights and sunny days therefore give the California fruit more "character" and color; it is both more sweet and more sour. The moister and more equable climate of Florida, on the other hand, while it produces a fruit with less pronounced flavor, tends to develop the more delicate features of the flavor, which are due to ethers or volatile oils.

These varying climatic results are easily seen in the Marsh grapefruit, which when properly matured in California is said to have a richer flavor than in Florida. Commercially, California cannot compete with Florida on even terms in supplying grapefruit to the eastern market, because the latter can market fruit at much less expense. The California growers, aside from supplying the home market, endeavor to supply the eastern market during late summer and early fall, when little

[1] See "Washington Navel Orange," by A. D. Shamel, JOURNAL OF HEREDITY, Vol. vi, No. 10, pp. 435–445, October, 1915.



THE APPROVED TYPE OF MARSH GRAPEFRUIT

It is a flattened fruit with a smooth, fairly thin skin, no seeds and an abundance of juice. It originated under unknown circumstances in Florida a generation ago, and quickly became the most popular variety in America. All the California commercial growers have agreed to produce a grapefruit like the above, and no other. Photograph from the U. S. Department of Agriculture. (Fig. 20.)

or no Florida grapefruit is being shipped.

In the past, California grapefruit has usually been picked in winter, and has been considered inferior to the Florida fruit. It is now believed that this inferiority is due to premature picking: that the fruit does not really ripen until about May. The Grapefruit Club will therefore adopt a "standard of maturity" just as the orange growers have done. No orange may be shipped unless it contains eight parts of soluble solids (mostly sugar) to one part of acid, and the Interstate Commerce Commission prosecutes any grower who ships his fruit before it is legally ripe. The Florida standard for grapefruit is seven parts solid to one of acid; this may be modified in California.

The Grapefruit Club embraces the growers of 60% of all the grapefruit produced by California, all of them members of the California Fruit Growers' Exchange. They have decided not only to market their fruit according to standard, but to eliminate from their groves all varieties except the Marsh, and further to eliminate all Marsh except one approved type. Due to bud variation and careless propagation of inferior variants, there are now a number of types of Marsh grown in California: the standard is a smooth, flattened, juicy fruit, another is rough skinned, a third corrugated, a fourth full of seeds. The members are going over their groves, eliminating all trees that do not bear standard fruit, and topworking them or replacing them with new trees.

The two largest growers of grapefruit in California are not members of the Exchange and therefore not members of

A VARIATION OF THE MARSH GRAPEFRUIT

Like all other citrus fruits, the grapefruit is much subject to bud variation. On a good Marsh tree, a single limb will sometimes appear bearing rough, dry, pithy fruits like the one shown above. If the grower is not watching his trees carefully, he may propagate from this limb and then have a number of entire trees bearing the same worthless type of fruit. This is exactly what has happened to a considerable extent in the California citrus groves; the growers are now eliminating all inferior bud variations, including the one shown above, and retaining only approved types, taking care to propagate from the most productive trees of these. Photograph from the U. S. Department of Agriculture. (Fig. 21.)

the Grapefruit Club. They worked over their groves four years ago, eliminating all but the best type of Marsh; it was their success, indeed, that moved the Grapefruit Club to organize and act. The result will be that the whole California grapefruit industry is on a common basis, uniting on a single strain of a single variety, keeping this variety up to the mark by maintaining a performance record for every tree and eliminating those that show undesirable variation. In this effort they have the coöperation of the U. S. Department of Agriculture, and the greater part of the grapefruit buds propagated during the last five years have been pedigree buds furnished by the Department, which in the seven years of its bud selection work in California has distributed more than 2,000,000 buds of all kinds to citrus growers—all these buds being furnished gratis by owners of groves who were aiding the Department in its investigations.[2]

It has long been evident that the future of agriculture in the United States depends on organized coöperation of small landholders. The first

[2] See "Bud Variation," by A. D. Shamel, JOURNAL OF HEREDITY, Vol. vii, No. 2, pp. 82–87, February, 1916.

attempts were naturally in the direction of coöperative marketing. Extension of this coöperation to the improvement of varieties and breeds will have commercial results that can hardly be overestimated. Some of the live-stock breeders already have their "circuit bulls;" many have milk or butter-fat tests. Horticulturists are in the nature of things enabled to proceed even more rapidly, and the radical action of the California grapefruit growers will undoubtedly be followed by other branches of agriculture, as fast as the progress of genetics marks the way.

Another German Proposal to Increase the Birth Rate

A. Zeiler in *Die Grenzboten* (March, 1916) says in sum: The serious danger of being outnumbered by our eastern neighbors must be averted at all risks. Since the rising standards of living make large families nearly impossible, and since the gap between the mode of living of the unmarried or childless and the large family are the strongest reasons for a decreasing birth-rate, large families must be encouraged through economic assistance. A bachelor tax alone is inadequate, and the disadvantages of exemptions from taxation of heads of families are greater than the advantages. Only a proper balancing of the family burden through a general and proportional subsidy or pension will really help. These subsidies must be large enough to be effective and yet not so large as to eliminate the very principles upon which the family rests: the sense of responsibility and the willingness to sacrifice. The subsidy should be in the form of a gift for the girl who marries; annual contributions to the expenses of every home, whether there are children or not; and a grant for every child, graded according to age and education received. A tax amounting to about 3% of the total income, after an absolute minimum and a proportional subsidy had been deducted, would furnish the funds. A bachelor, the head of a family without children, and the head of a family with five children and an income of 4,000 M., for example, would pay a tax of 816 M. The childless family, however, would receive a compensation of 600 M. per annum, the family with five children not over 14 years of age, an additional sum of 712 M., while the bachelor would receive no compensation whatever.—Abstract in *American Journal of Sociology*.

Ewing's Study of an Aphis

Having bred a plant-louse (*Aphis avenae* Fab.) for eighty-seven generations, Prof. H. E. Ewing describes his study in the *Biological Bulletin*, XXXI, 2, pp. 53–113. The insects formed a parthenogenetic pure line, in which six different fluctuating variations were marked. Selections were made for ten or more successive generations in the case of three of these characters; for forty-four successive generations in one character; and were carried out in both plus and minus directions in the case of two characters. In all of these cases no summation of effect was produced by selection. The writer concludes, therefore, that such variations are not due to the germ-plasm. "The pure line theory," he holds, "applies to parthenogenetic arthropods as well as to forms that reproduce by budding, fission, or self-fertilization," but he points out that it is a great mistake to attempt to apply it to animals that reproduce sexually. A few abrupt variations were noted, but were not found to be inherited any more than the small fluctuations which were continually occurring.

The

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CONTENTS

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TOMATOES ABOVE GROUND, POTATOES UNDERNEATH

Considerable interest has been aroused by the quite general publication in the press of the country of the grafting of a tomato plant on a potato plant at the Pennsylvania State College, and the institution was credited with the conception of the experiment.

From the widespread interest that has been manifested, it would appear that the idea is a new one, while, as a matter of fact, it has been common knowledge of botanists and horticulturists for many years. The idea did not originate at the Pennsylvania State College, neither is it considered especially remarkable nor of great economic value.

In order to demonstrate the ease with which these two closely related plants may be grafted, one attempt was made, the common inverted "saddle graft" method being used. The plant was wrapped with raffia at the junction of the two pieces and was then placed in a humid atmosphere for several days until the union was perfected. Later the plant was shifted to the outside where little attention was given it. Later tubers developed on the potato part and tomatoes on the top.

The illustration shows the general appearance of the plant, the value of which is inversely proportional to the amount of attention it has received. (Frontispiece.)

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SOUTHERN STRAWBERRIES

Most of the Varieties Grown There Are Due to Skill of Two Breeders—Their Method of Operation—Still Room For Further Breeding

GEORGE M. DARROW

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ABOUT forty years ago a boy named Robert L. Cloud was helping his father grow strawberries in Louisiana for the New Orleans market. The varieties grown at that time had been imported from abroad and from the North. They bore soft fruit and were not adapted to a southern climate. He realized that varieties were needed which would keep better under the hot mid-day sun of the South, and he began trying to breed such varieties.

Ten years later, Robert L. Cloud was the railroad shipping agent at Independence, La., and superintended the shipment of the first iced refrigerator car of strawberries ever sent to the northern markets. This experience enabled him to see just what kind of a berry was needed. With such a training began the career of one of the most successful of American berry breeders.

Mr. Cloud knew the characteristics of all the best varieties previously grown. He picked out some poor varieties that were good shippers and some good varieties that were poor shippers and began to cross them. In 1889 he had already put two of his crosses, Cloud and Big Bob, into the trade and since the time of their introduction the varieties grown in Louisiana, as well as in some other parts of the South, have consisted entirely of those produced by Mr. Cloud.

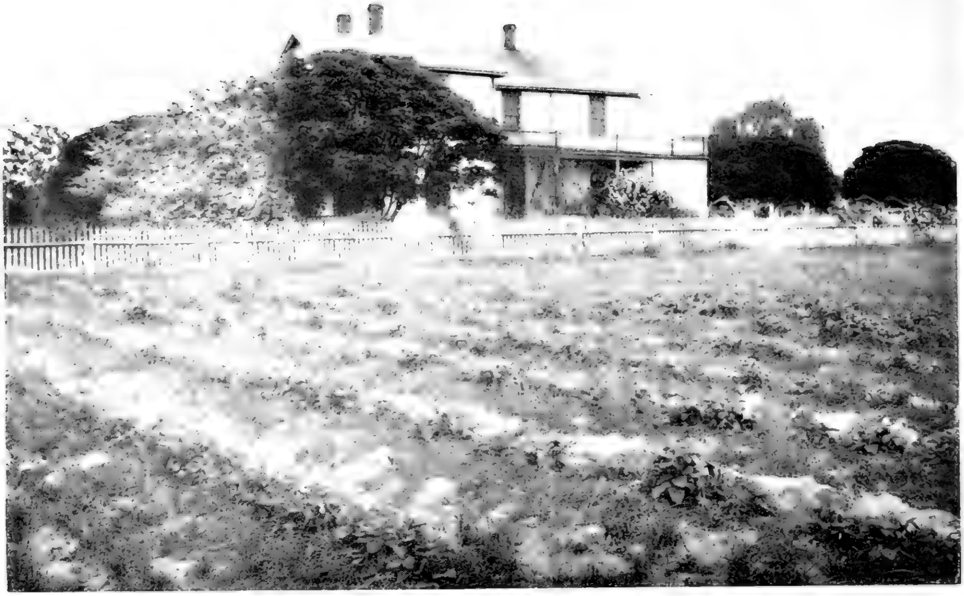
At the time of the Civil War, the Early Scarlet, a variety very aromatic and similar to wild strawberries, was grown in Louisiana. The Peabody-hoboy was the next to be taken up. Following this in succession were grown the Prince Imperial, a variety introduced from France; Mary Stuart, a pistillate[1] variety; Crescent, another pistillate variety; and then the Wilson. Next came the Cloud and Big Bob, and they were the leading varieties from the time of their introduction until Mr. Cloud introduced the Klondike in 1901. Other varieties, the Lulu and the Pickerproof, were originated by him between 1888 and 1901, but neither proved as desirable as the Cloud and Big Bob.

Mr. Cloud is still at work originating new varieties. In a shaded place in which the seed is sowed are seedlings just showing through the ground. In different parts of his fields in which he raises berries for market are to be found new varieties which he is testing side by side with the Klondike, the standard variety of his section. Two of his new varieties he plans to introduce at an early date. These he calls the Payday and Perfecto.

THE NEWEST IMPROVEMENTS

The Payday is the result of a cross between a seedling used only in breeding work and the Klondike. An inter-

[1] Commercial varieties of strawberries fall in two classes: those with perfect flowers, including both stamens and pistils; and those whose flowers lack the male element, and are called pistillate. It is obvious that if plants of the second type are grown exclusively, the flowers can not be fertilized, and will produce no fruit. Tyros have sometimes planted a bed of one variety—a pistillate one—and have been quite astonished that it yielded nothing, although it flowered freely. The pistillate varieties are rapidly going out of use, growers tending to plant only perfect-flowered varieties in order to avoid this difficulty. The two types of flowers are illustrated by photomicrographs in connection with "Ettersburg Strawberries," by Roy E. Clausen; JOURNAL OF HEREDITY, VI, pp. 324-332, July, 1915.



WHERE MANY FAMOUS STRAWBERRIES ORIGINATED

Home of R. L. Cloud, Hammond, La. In the garden around this house were produced the Klondike, Cloud, and other widely grown varieties. The field in the foreground is at present occupied by Payday, a variety which Mr. Cloud plans to introduce to the trade. (Fig. 1.)

esting characteristic of this seedling used as one of the parents in producing Payday is that on any one plant a few flowers have stamens but most of them have none.

The Payday, says Mr. Cloud, is the best of the two new varieties, and he regards it as an improvement over the Klondike. He reports it to be superior to the Klondike in the number of crowns made by the individual plant, in the vigor of the plant, in having the stems of the berries recurved, in having a darker colored berry, in bearing fruit of better quality, and in having a shorter period between the blossoming time and the ripening of the fruit.

Believing that a large number of crowns in a plant indicates productiveness, he has endeavored to secure a variety having many crowns. One characteristic of the Klondike which helped to make it a success is its rich red color and in his later work Mr. Cloud has endeavored to get seedlings bearing berries of a still deeper color.

Mr. Cloud correlates acidity of fruit with good shipping quality and in his recent work has tried to secure a variety with the acidity of the Klondike. The Payday has a strongly acid berry, but combined with the acidity, a more desirable flavor.

To get earlier ripening varieties, two lines of work have been followed. Some varieties have flower-stems that curve as soon as the petals begin to drop. In a very short time the green berries are protected by the foliage of the plant. Frosts, cold winds, or rains are not as likely to injure berries borne on the recurved stems as on stiff, straight stems.. Another way to secure earlier berries is to lessen the period between the

A PERFECT STRAWBERRY BLOSSOM

In the center is a compact mass of pistils, short tubes each of which leads down to a seed. Around these pistils are the stamens surmounted by capsule-like anthers filled with pollen. Usually fertilization takes place through pollen which bees bring from other strawberry blossoms and which brushes off their heads and legs on to the pistils. It is obviously necessary to have some of these "perfect" flowers in the strawberry bed, if fertilization is to take place. But some varieties bear flowers which have no pollen; they are imperfect or pistillate. Unless such varieties are interplanted with perfect-flowered varieties, no crop will be produced. Photograph by John Howard Paine, much enlarged. (Fig. 2.)

time of bloom and of ripe fruit. Mr. Cloud considers that he has succeeded to some degree in combining both characteristics in the Payday.

Like other plant breeders who have had long experience, Mr. Cloud can detect plant characteristics and differences indistinguishable to one lacking

similar training. It is no doubt this ability together with an accurate conception of the requirements of a good commercial variety that has led to his success.

The parentage of Mr. Cloud's strawberries was given by him as follows:

Cloud	Crescent x Wilson.
Big Bob	Cumberland Triumph x Neuman
Lulu	Crescent x Neuman.
Pickerproof	Lulu x Hoffman.
Klondike	Pickerproof x Hoffman.
Payday	Unnamed seedling x Klondike.
Perfecto	Unnamed seedling x Klondike.

THE WORK OF LOUIS HUBACH

Another very successful strawberry breeder in the southern States also began his work when only a boy. Louis Hubach, to whom I refer, made his first cross-pollinations when he was 14 years old. That was in 1886, and he is still making them.

He was born in Prussia on June 15, 1872, and came to this country when he was 9 years old. His father, a nurseryman, both in Germany and after coming to this country, trained him in the nursery work, and since his father's death he has run a small nursery of his own at Judsonia, Ark.

In addition to managing the nursery, Mr. Hubach has been a grower and breeder of strawberries. When only 20 years old, he originated the Excelsior, the best known of all his varieties. This was introduced in 1897, and is still the standard berry of its season in the South as well as in some parts of the North and West.

Mr. Hubach's first cross was the Crescent x Chas. Downing. From this he secured the Bush Cluster, a pistillate variety used in his later breeding work. In 1892, he secured both the Excelsior and the Hathaway (also called Early Hathaway and Texas), as the result of a cross between the Hoffman and the Wilson. In 1893, he originated the Fremont Williams (Bush cluster x Gandy), a very late variety which is proving to be desirable in the extreme northern part of the eastern United States.

The Hathaway and Hubach were introduced in 1902. In 1903, other varieties originated by Mr. Hubach were introduced under the names, Arkansas Black, Annie Hubach, Early Market, Peerless, Alice Hathaway, Mellie Hubach, Sunny South, Oscar's Early, Ford, Minnie, Evergreen, Maggie Watts, Carrie Dumas, Myriad, Brundidge, and Johnson's Early. Of these Mellie and Early Market are still grown commercially to a slight extent.

Later Mr. Hubach originated the Eureka which he sold to the Judsonia Fruit and Vegetable Growers' Association. Although still grown it did not prove to be as good as standard varieeties. Other varieties introduced by him are the H & H, Benancie, Newman, Wide Awake, Mountain View, Alvin, Early Harvest, Jim Dumas, and Champion K. The Champion K is his most recent introduction and is a cross between a pistillate variety and the Klondike.

Mr. Hubach uses only pistillate varieties as mother plants in breeding. His experience has been that when he has crossed perfect-flowered with perfect-flowered varieties the progeny lost in productiveness. In an experiment in which he tested this, he found that the decrease in yield continued for several generations. On the other hand, when an imperfect-flowered variety was used as the mother plant, an increase in productiveness often occurred.

Because of this experience, Mr. Hubach developed several varieties having imperfect flowers which are used in breeding only. One such variety with very firm fruit seems to be able to transmit this firmness to all its progeny. Others of these varieties are used when other characters are desired in the seedlings.

Mr. Hubach's breeding methods are interesting. He grows, in a separate plot, four plants of each pistillate variety which he wishes to use. At the beginning of the flowering period, he encloses the four plants in a wooden frame covered with a white cloth of fine weave—preferably silk cloth. When a cross is to be made, a flower from a plant having perfect bloom is picked early in the morning and is placed in an inverted position on one of the flowers

REPRODUCTIVE ORGANS OF THE STRAWBERRY

In the above photograph a portion of a perfect flower has been cut out and highly magnified. The pistils terminate in rough, sticky surfaces, to which a falling grain of pollen readily adheres. It soon begins to germinate, and sends a long tube down the pistil, until it reaches the base where the ovule is located. The nucleus of the pollen grain slips down the pollen-tube and unites with the ovule, thus completing the fecundation of this particular seed. Every pistil must receive a grain of pollen, if all the seeds are to grow. Photograph by John Howard Paine. (Fig. 3.)

under the cloth frame. Pollen falls on the pistils and fertilization takes place.

Seed from the resulting berries is collected, cleaned, and kept one year. Mr. Hubach says that the weaker seed is killed by being stored while the good seed starts better. It is then soaked in water for three days and planted about the middle of May in sterilized soil composed of half sand and half well-rotted stable manure. The seed usually germinates readily and the young plants appear in three or four days. They are grown in a lath house under two-thirds shade and are watered carefully with a fine spray. When the plants have three or four leaves, the ones with undesirable characteristics are discarded. Correlation of characters makes it possible to discard most of the undesirable ones at this time.

The year after that in which the seed was planted, fruit will be borne. From among the seedlings thus produced, Mr. Hubach selects the one nearest to his ideal. If it lacks some desirable character he crosses it on the one of his pistillate varieties which he has found will supply the missing character. From the resulting seedlings he expects to secure his ideal.

Following the plan outlined, Mr. Hubach has been working toward an ideal variety for each season. Thus he has attempted to secure a variety with the desirable characters of the Klondike, but better in certain respects. Such a variety he considers the Famous to be. It ripens two weeks earlier than the Klondike and slightly earlier than the Excelsior at Mr. Hubach's place. The berries are similar to the Klondike in shape and color. They are slightly larger than the Klondike and run very uniform throughout the season. The berries are borne on long stems with one berry to each stem to a greater extent than are the berries of the Klondike. Mr. Hubach believes that a variety bearing a large proportion of its fruit on such individual stems coming from the crown of the plant will yield berries of more uniform size through a long season, and he is, therefore, breeding for a variety which shall have a stem for every berry.

If the Famous proves generally as productive, firm, and free from diseases as it has on Mr. Hubach's place, it should be a valuable addition to the list of varieties for the South.

Mr. Hubach is trying to produce a variety as late as the Aroma but with the desirable characteristics of the Klondike, and which may be grown with the Klondike or Famous. Such a variety Mr. Hubach considers that he has originated and he is testing it on a commercial scale.

He has not found northern varieties suitable for use in breeding work as the berries are too soft for long shipments. A firm berry is absolutely necessary for southern growers. Until two years ago, Mr. Hubach maintained a collection of strawberries in which he says there were about 2,200 varieties. He found it too expensive to maintain and destroyed it. From a study of the collection, however, he secured a broad knowledge of the material available for use in breeding. The collection was undoubtedly by many times the largest collection ever brought together in America.

OTHER STRAWBERRY BREEDERS

I have described the work of these two men in some detail so that any one else who wants to try strawberry breeding may know how it has been done with great success by others. Some of the other Southerners who have contributed to the great development of the strawberry industry in the South should also be mentioned.

J. C. Bauer, of Judsonia, Ark., has originated and introduced the St. Louis and the Gold Mine. The former is a very productive early variety suitable for home use and local market, but rather soft and light colored for the general market. The Gold Mine is a late variety too recently introduced to have its value determined. Mr. Bauer is still trying to secure better varieties.

Other men have found seedlings growing near packing houses, in the woods, by the railroad track, or in other places where seed chanced to germinate.[2] In this way, W. W. Wallace, of Harriman, Tenn., found the Three W and other varieties; D. C. Tibbs, of Nashville, Tenn., found the Champ Clark and the Nicaragua; Mrs. David Thompson, of Mt. Olive, N. Car., the Thompson (Lady Thompson); V. S. Babcock, of Norfolk, Va., the Jamestown; Nathaniel Gohn, of Norfolk, Va., the Missionary; Caleb Price, of Mt. Olive, N. Car., the Price; Mr. Murray, of Magnolia, N. Car., the Murray; Mr. Faison, of Faison, N. Car., the Dixie (Dixie Belle); R. G. Thomas, of Greensboro, N. Car., the Greensboro; and Geo. Mitchel, of Judsonia, Ark., the Mitchel.

Thirty years ago there were practically no strawberries shipped out of

[2] Bud variation seems to have played little part in the recent improvement of the strawberry. The only instance on record is the reputed appearance of the fall-bearing or ever-bearing strawberry, the first variety of which (Pan-American) was introduced from Delevan, N. Y., in 1898, and was said, although without definite proof, to be a bud sport of the summer-bearing variety Bismarck. Some plants of the variety Missionary in Florida show an elongation of the fruiting stems to about three times the normal length, a change that may be ascribed to bud variation. Bud selection has been attempted over a long period of years by two experiment stations without any increase in yield.

FIRST STAGE IN GROWTH OF A STRAWBERRY

After the ovules have been fecundated, the petals drop from the flower, leaving it in the condition shown above. The seeds, one of which is located at the base of each pistil, begin to develop, soon afterward the pollen-bearing stamens wilt and fall off, and the pistils begin to shrivel up. Photograph by John Howard Paine. (Fig. 4.)

the South. Let us see just what net result the work of all these breeders has produced. If we turn to statistics we find that in 1914 the commercial shipments of fresh strawberries in the United States totaled 14,553 carloads. Of these 8,369 carloads came from southern States and largely from sections in those States to which the strawberry is not native. The greater part of the shipments consist of varieties originating in the South as the result of definite breeding work, and in the following table is shown the percentage of the total acreage represented by each variety together with the place of origin of most of the varieties.

THE BERRY BEGINS TO DEVELOP

Botanically speaking, the strawberry is not a berry at all. It is what is called an accessory fruit, consisting of a lot of seeds on the outside of a "receptacle." This receptacle is, in fact, merely an enlargement of the end of the stem. As the seeds develop, the end of the stem—the so-called receptacle—also develops, and soon does so very rapidly. At the stage shown above the seeds have developed until they quite dwarf the shriveled stamens; at the same time the receptacle has swelled up until the typical berry appearance is seen. The seeds will presently ripen and harden, and the receptacle will continue to swell until it forms the delicious mouthful which led the Bishop to exclaim, "Doubtless God could have made a better berry, but doubtless God never did." When mature, the seeds are so small that they are hardly felt in the mouth; yet it must not be forgotten that they alone are, in a botanical sense, the fruit of the plant, the enlarged stem-end, although much more important to man, being of little consequence to the plant, and merely an accessory to the seeds. Photograph by John Howard Paine. (Fig. 5.)

SEEDS OF THE STRAWBERRY

Part of the surface of a large, fully ripe strawberry is here shown, highly magnified. The shriveled pistils can still be seen projecting from under the seeds, except in a few cases where they have been rubbed off. As the edible "berry" is functionally merely a structure to carry the seeds, its size is roughly proportional to the number of seeds borne. It will therefore probably never be possible to breed a seedless strawberry, or even to reduce the number of seeds materially, for to do so would leave no reason for the existence of the "berry" and it would therefore not be formed. Photograph by John Howard Paine. (Fig. 6.)

This table shows that practically all varieties grown in the South originated there. The Aroma and Gandy are the chief exceptions and they are grown

Origin of Varieties of Strawberries Grown in the South, Exclusive of the States of Kentucky, West Virginia, Maryland and Delaware.

Variety	*Extent grown in the South. % of total acreage*	*Where originated*	*By whom*
Klondike	79	Hammond, La.	R. L. Cloud.
Aroma	8	Kans.	F. W. Cruse.
Missionary	7	Norfolk, Va.	Volunteer.
Gandy	2	Newport, N. J.	Volunteer.
Excelsior	2	Judsonia, Ark.	Louis Hubach.
Thompson	1	Mt. Olive, N. Car.	Volunteer.
Hathaway	slightly	Judsonia, Ark.	Louis Hubach.
St. Louis	slightly	Judsonia, Ark.	Louis Hubach.
Mitchel	slightly	Judsonia, Ark.	Volunteer.
Jamestown	slightly	Norfolk, Va.	Volunteer.
Dixie	slightly	Mt. Olive, N. Car.	Volunteer.
Ozark	slightly	Sarcoxie, Mo.	Chas. Shull.
Neuman	slightly	No. or So. Carolina	
Nick Ohmer	slightly	Dayron, Ohio.	J. F. Beaver.
Market	slightly	Judsonia, Ark.	Louis Hubach.
Eureka	slightly	Judsonia, Ark.	Louis Hubach.
Mellie	slightly	Judsonia, Ark.	Louis Hubach.
Champ Clark	slightly	Nashville, Tenn.	Volunteer.
Bubach	slightly	Princeton, Ill.	J. E. Bubach.
Hefflin	slightly	N. Car.	
Three W	slightly	Harriman, Tenn.	Volunteer.
Corneille	slightly	Pouchatoula, La.	

only in the northern part. Of the leading varieties originating in the South, the Missionary and the Thompson were found as seedlings and brought into cultivation. They form 8% of the total, while the Klondike and Excelsior which are the result of definite breedingwork constitute 81% of the total. Further, certain of these varieties are grown extensively elsewhere. Thus the Klondike is a leading variety in California, Illinois, Maryland, and Delaware.

The strawberry stands forth as one of the conspicuous examples of successful breeding and it is doubtful if any other fruit in the United States can show as remarkable a record.[3] The modern industry is, in fact, almost wholly the creation of modern scientific breeding. But the work is not finished. There is still room for improvement and opportunity for the production of better varieties. The breeders of the South say, as the result of their experience, that the ideal strawberry of the future should possess the following qualities:

1. The plant should be as disease-resistant as the Aroma.
2. It should make runners as freely as the Klondike or Aroma.
3. It should be at least as productive as the most productive variety in each section.
4. It should have a perfect flower.
5. The blossoms should be as well protected from frost as the Missionary.
6. The berries should be as uniform in size throughout the season as are the Aroma and Chesapeake in sections to which they are adapted.
7. The berry should be as uniform in shape as the Chesapeake in sections to which it is best adapted.
8. The berry should be as firm as the Klondike is in the South.
9. The berry should be as solid as the Klondike.
10. The berry should be at least as large as the Klondike.
11. The berry should have as red a flesh as the Klondike.
12. The fruit should be as easy to pick as the Klondike.

There are other characteristics that are desirable in varieties adapted to special purposes. Growers in central Florida must have a variety that ripens very early and continues to ripen through a long season as does the Missionary. Canners do not like a berry having a cap as hard to remove as that of the Klondike. They do, however, desire varieties with its deep red color, and strong acid flavor. They also like a berry that retains its shape after cooking. Growers in some sections wish an early variety, the crop of which will ripen quickly, and be out of the way in order that they may turn to other farm work needing attention. Others wish two quick-ripening varieties, one following the other in season.

Studies of Inheritance in Guinea-Pigs and Rats

STUDIES OF INHERITANCE IN GUINEA-PIGS AND RATS, by W. E. Castle and Sewall Wright. Pp. 192, 7 plates, price $2.50. Washington, D. C., Carnegie Institution, 1916.

Part I of this highly technical volume is an account by Dr. Castle of a trip to the home of the guinea-pig in Peru. He concludes that probably all of the differences in coat-color which fanciers now recognize appeared in South America, where guinea-pigs have been bred for centuries as a source of meat, and observes that "the guinea-pig has undergone in domestication more extensive variation in color and coat characters than has any other mammal." He brought back three new races, and describes hybridization experiments with them. In Part III, Dr. Castle continues his studies on selection in piebald rats, adding to the evidence for a modification of the unit hooded character,and describes a case of gametic coupling in yellow rats. In Part II, Dr. Wright makes "an intensive study of the inheritance of color and of other coat characters in guinea-pigs with especial reference to graded variations," in the course of which he develops a suggestive hypothesis to explain the physiological basis of the inheritance of coat color.

[3] Compare "The Strawberry, a Triumph of Plant Breeding," in the JOURNAL OF HEREDITY VII, p. 191, April, 1916.

THE TIDE OF IMMIGRATION

Indirect Results on Eugenics are Quite as Important as Direct Results—Admission of Too Much Unskilled Labor Said to be Partly Responsible for Fall of Birth Rate in Old American Population

A Review

THERE are now in the United States some 14,000,000 foreign-born persons, together with other millions of the sons and daughters of foreigners, who although born on American soil have as yet been little assimilated to Americanism. This great body of *Uitlanders*, representing perhaps a fifth of our population, is not a pool to be absorbed, but the emptying in of a continuous stream, which, until the war, was steadily increasing in volume, and of which the fountain-head is so inexhaustible as to appal the imagination.

The character of this stream will inevitably determine to a large extent the future of the American nation. The direct biological results, in race mixture, are important enough, although not easy to define; the indirect results, which are probably of no less importance to eugenics, are so hard to follow that some students of the problem do not even realize their existence.

A few thinkers have indeed been pointing out for many years that the consequences of this immigration are much more far-reaching than we suppose. The American Genetic Association's committee on immigration has been persistently urging[1] that the problem of regulating immigration should be lifted above the plane of party politics and placed in the field of statesmanship. The present war, which has temporarily almost stopped immigration, gives the nation an excellent opportunity to take stock of its affairs and adopt a rational policy for future guidance.

For this purpose we need all the facts available, and Frank Julian Warne, special expert on foreign-born population of the thirteenth United States census, has done a service in publishing an account of "The Tide of Immigration."

Dr. Warne's book[2] is not a masterpiece—it shows much use of the scissors and paste-pot, and an atmosphere of special pleading. It has neither the brilliancy nor the biological viewpoint of such a work as Prof. E. A. Ross's "The Old World in the New." But it will be very serviceable because it is timely, because it brings together a great amount of information, and because it is rich in the little details of politics which will be uninteresting five years hence, but which just now one wants very much to know.

OLDER AND NEWER IMMIGRATION

Dr. Warne follows the usual course by describing the immigration of the first three-quarters of the nineteenth century, most of which was from races closely allied to the Anglo-Saxon, and which strengthened the United States immensely. Then he tells how this stream dried up and was succeeded by a flood of Southern Italians, Slavs, Greeks and Russian Jews, and last of all by an overflow from the Eastern Mediterranean. A large part of the later immigration is "promoted;" agents of

[1] See "First Report of the Committee on Immigration," *American Breeders' Magazine*, Vol. iii, pp. 249–255, 1912; "Second Report of the Committee on Immigration," JOURNAL OF HEREDITY, Vol. v, pp. 297–300, 1914; "War, Immigration, Eugenics," Third Report of the Committee on Immigration, JOURNAL OF HEREDITY, Vol. vii, pp. 243–248, 1916.

[2] "The Tide of Immigration," by Frank Julian Warne. Pp. 388, price $2.50 net. New York, D. Appleton & Co., 1916.

transportation companies and others who stand to gain stir up the population of a country village in Russia or Hungary, excite the illiterate peasants by stories of great wealth to be found in the New World, take a mortgage on the farm, provide the immigrant with a ticket and start him for Ellis Island. Or else the immigration represents a floating supply of casual laborers, who drift in during a period of prosperity in America, and drift out when business depression curtails the demand for their muscle. "The fact is, and a startling fact it is, too, immigration today and in the large has become a colossal business enterprise—a huge commercial undertaking—the wholesaling of human labor for gain." "The religious and political motives have almost wholly disappeared in favor of the economic in modern immigration." Naturally, such immigration is predominantly male. On the whole, females make up one-third of the inflow, but among some races—Greeks, Italians and Roumanians, for example—only one in five is a woman.

Most of the immigrants are merely ignorant, vigorous peasants, imbued with a natural desire to make money. There is, however, a considerable element of undesirables—it is on this element that eugenicists have fixed their attention, perhaps too exclusively, in the past. Dr. Warne charges that many of these undesirables are informed that the immigrant rush is greatest in March and April, and that they therefore make it a point to arrive at that time, knowing the medical inspection will be so overtaxed that they will have a better chance to get by. When three or four thousand immigrants arrive in a single day, the examiners must pass them almost as rapidly as the conductor on the street car punches transfers; and it is naturally difficult to arrive at any sound judgment, as to the alien's physical, mental, moral, and economic status and the possibility of his becoming a public charge.

The American Genetic Association has long demanded an increase of the facilities for inspection. But no increase would shut out all undesirables. Insanity, for example, appears among the aliens to such an extent that a large part of the inmates of State hospitals in States on the Atlantic seaboard are foreign-born.[3] Probably few of them were actually insane when they passed through the port of entry. Insanity, it must be remembered, is predominantly a disease of old age, whereas the average alien on arrival is not old. The mental weakness appears only after he has been here some years, perhaps inevitably or perhaps because he finds his environment in, say, lower Manhattan Island much more taxing to the brain than the simple surroundings of his farm overlooking the bay of Naples.

The difficulty or impossibility of shutting out individually all the undesirable immigrants is so marked that many students, including Dr. Warne, have decided that the easiest and most effective solution is to put a wholesale restriction on immigration, such as is contemplated by the literacy test, which is designed not so much as a sieve, but as a measure to cut down the volume of arrivals. Such a restriction would likewise, it is claimed, diminish the social problems which the huge volume of immigration creates.

With the general character of these social problems we are all familiar. Though it is true that much of America's social progress is due to the immigrants of the past century, it is not less true that the immigrants of the last generation have created some very difficult problems with their low standards of living and their inability to understand American ideals and institutions.

These social difficulties, important enough, are more obvious and less insidious, probably less serious, than the economic difficulties which are laid to immigration. The immigrant arrives

[3]Of the total number of inmates of insane asylums of the entire U. S. of January 1, 1910, 28.8% were whites of foreign birth, and of the persons admitted to such institutions during the year 1910, 25.5% were of this class. Of the total population of the United States in 1910 the foreign-born whites constituted 14.5%.—Special report on the insane, Census of 1910 (published in 1914).

with a low standard of living. With prosperity and the example of Americans, he gradually adopts a higher standard of living; and just at that time his industry is swamped with a new flood of immigrants with lower standards, which drags down those who would otherwise rise. Such is one view of the case; others reply that, on the contrary, the influx of unskilled labor creates industries which mean more wealth and better jobs for the earlier arrivals, and for the old American stock.

ECONOMIC CONSEQUENCES

Obviously, the ultimate effects of immigration depend largely on the question which of these views is more nearly correct. It is a question of whether the Americans and older immigrants must directly compete for jobs with the new arrivals, or whether the new arrivals, although competing with each other, really furnish jobs for the longer-established and more skilled residents of the country. Truth is doubtless to be found on both sides, but Dr. Warne leans to the first view, and cites the Immigration Commission, among other authorities, in his support. Prof. H. P. Fairchild of Yale is quoted as follows:

"It is claimed that the natives are not displaced, but are simply forced into higher occupations. Those who were formerly common laborers are now in positions of authority. While this argument holds true of individuals, its fallacy when applied to groups is obvious. There are not nearly enough places of authority to receive those who are forced out from below. The introduction of 500 Slav laborers into a community may make a demand for a dozen or a score of Americans in higher positions, but hardly for 500. Furthermore, in so far as this process does actually take place, it must result in a lowering of the native birth rate, for it is a well-known fact that in all modern societies, the higher the social class, the smaller is the average family."

Prof. Jeremiah W. Jenks, formerly a member of the Immigration Commission, wrote to President Taft that "The number of unskilled workers coming in at the present time is sufficient to check decidedly the normal tendency toward an improved standard of living in many lines of industry. . . . Figures collected by the Immigration Commission, from a sufficient number of industries in different sections of the country to give general conclusions, prove beyond doubt that in a good many cases these incoming immigrants actually drive out into other localities and into other unskilled trades large numbers of American workingmen and workingmen of the earlier immigration who do not get better positions but rather, worse ones."

With this standpoint, Dr. Warne concludes, "We must consciously realize that it is not conducive to the success of American democracy that the native worker should be content with a standard of living as low as that of the [present] immigrant. This American is more than an industrial toiler; he is a citizen; also, he is a husband and a father. His wants are naturally greater in number and these he can satisfy only through wages. He is subject to inescapable pressure from all those social, religious, political, educational, and economic forces which are back of that constant tendency so noticeable in the United States for the standard of living of the people to increase. The wages of the native worker should be released sufficiently from the competition of the immigrant to permit that elasticity which keeps wages within promising distance of the standard of living. This can be influenced in part through better governmental regulation of the volume of immigration."

INCREASING THE BIRTH RATE

The conclusion is worth emphasizing because, if well founded, it has an important bearing on eugenics. It is pretty well recognized now that the low birth rate among the most useful and enlightened classes is principally economic in origin, and that it is useless to try to get people to have children if they cannot afford it. Any successful

eugenic propaganda must, therefore, be preceded by such economic and social changes as will make it economically and socially possible for young married people to have children; and it seems probable that a restriction of the volume of unskilled labor arriving in this country would be one of those changes.

Dr. Warne devotes two chapters to the argument that better distribution of immigrants, which is sometimes proposed as a panacea, would in reality produce little result. Apparently he would hardly go even as far as President Roosevelt who said that "distribution is a palliative, not a cure." Then, feeling sure that a considerable restriction of the inflow is desirable, he takes up the discussion of how this is to be secured.

The Immigration Commission appointed by President Roosevelt in 1907 made a report to Congress on December 5, 1910, in which it declared in favor of restriction and suggested the following possible methods:

1. The exclusion of those unable to read or write in some language.

2. The reduction of the number of each race arriving each year to a certain percentage of the average of that race arriving during a given period of years.

3. The exclusion of unskilled laborers unaccompanied by wives or families.

3. The limitation of the number of immigrants arriving annually at any port.

5. Material increase in the amount of money required to be in the possession of the immigrant at the port of arrival.

6. Material increase of the head tax.

7. The levying of the head tax so as to make a marked discrimination in favor of men with families.

Eugenically, it is doubtful whether (3) and (7), which would tend to admit only families, would be a gain or a detriment to the welfare of the race. (1) and (2) have been the suggestions which have aroused the most controversy. All but one member of the commission favored (1), the literacy test, as the most feasible single method of restricting undesirable immigration and, as readers know, three attempts to enact it into a law have been made, but have been defeated by the vetoes of President Cleveland, Taft and Wilson. The measure is now pending before Congress again. Dr. Warne's enumeration of the influences for it and against it is enlightening and interesting.

PREVALENCE OF ILLITERACY

Records for 1914 show that "illiteracy among the total number of arrivals of each race ranged all the way from 64% for the Turkish to less than 1% for the English, the Scotch, the Welsh, the Scandinavian and the Finnish. The Bohemian and Moravian, the German, and the Irish each had less than 5% illiterate. Races other than the Turkish, whose immigration in 1914 was more than one-third illiterate, include the Dalmatians, Bosnians, and Herzegovinians; Russian Ruthenians, Italians, Lithuanians, and Roumanians."

To bar these illiterates, Elihu Root said, would be an advantage because "the coming of great numbers of people who are wholly illiterate and who have to take, of course, the lowest rate of wages, whose minds are not open to the ordinary opportunities for bettering their condition, does tend to break down the American standard of wages, and to compel American workmen, whether they be born here or be a part of the 9,000,000 who have come in since the war with Spain, to compete with a standard of wages and a standard of living that they ought not to be required to compete with."

It will, Dr. Warne admits, keep out some who ought to come in, and let in some who ought to be kept out. It is, he grants, a test of opportunity rather than of character. It is not claimed to be perfect, or to be a test of the real character of the immigrant.

"The literacy test is simply and solely a restrictive test and is proposed as such. In the belief of its advocates, it will meet the situation as disclosed by the investigation of the Immigration Commission better than any other means that human ingenuity can devise. It is believed that it would exclude more of the undesirable and a less

number of the desirable immigrants than any other method of restriction. It goes to the root of the evils, which are largely economic."

TEST A MERE RESTRICTION

"The literacy test is not aimed primarily at illiteracy. It is not aimed at the immigrant as such. Under favorable conditions the illiteracy of the immigrant is sooner or later remedied. It is not directed against any particular race or against aliens from any particular country. It is directed primarily against the volume of immigration, and is justified in the fact that the conspicuous character of large numbers of immigrants is their inability to read and write. And the literacy test is aimed at the quantity of immigration primarily, and solely for the purpose of bringing it within a reasonable degree of our ability to absorb and assimilate its elements."

In spite of its three defeats, it seems likely that the literacy test as a restriction of immigration will again be passed by Congress this winter, that it will again be vetoed by President Wilson, and that another attempt will be made to pass it over the President's veto. This reopening of the question offers an opportunity of which eugenicists should take advantage. Whatever their views as to the best method of restriction may be, they should attempt to get more widespread a realization of the eugenic implications of excessive immigration, not only in the bad breeding which results from the admission of a certain number of physical and mental undesirables; but indirectly from the economic results. If they believe that excessive immigration of unskilled labor is partly responsible for the conditions which make it hard for a larger part of the population to have any, or enough, children, they should keep this fact to the front. Every such effort will aid to bring nearer the social and economic readjustments which a policy of national eugenics requires.

Pollination Studies on California Fruits

Plum and prune pollination investigations have been carried on during the past three years by Hendrickson at the California State Agricultural Experiment Station. Observations in 1915 on 50,000 plum and prune blossoms and on 87,000 during 1916 show definitely that all varieties of the Japanese group of plums (*P. triflora*) are self-sterile with the possible exception of Climax. The varieties of this group seem to cross-pollinate readily. Of the European varieties of plums (*P. domestica*), Tragedy and Clyman show distinct evidences of self-sterility. French and Sugar prunes seem to be self-sterile to some extent. Robe de Sergeant and Imperial prunes are distinctly self-sterile. Imperial, French, and Sugar prunes seem to cross-pollinate satisfactorily.

An important observation during the season of 1916 has been the noticeable lack of pollinating agencies in some prune orchards. The normal set of French prunes was about 4% as compared with 19% on a tree which was covered with a mosquito net tent under which the bees were confined.

During 1916 observations on almonds by Tufts show that there is a distinct pollination problem with this fruit. Thirteen varieties, including practically all grown on a commercial scale in California, proved to be wholly self-sterile under conditions existing at the university farm. Of still greater importance is the fact that the Nonpareil and I. X. L., two of the leading varieties, were found to be intersterile as well as self-sterile. Ne Plus Ultra was found to be very satisfactory as an interpollinizer with both I. X. L. and Nonpareil.

Observations during 1916 by Tufts on cherries show that the leading commercial varieties grown in the State, including Napoleon (Royal Ann), Lambert, Bing, Black Tartarian and Black Republican, are self-sterile. There is also distinct evidence of intersterility between several varieties, for example, Bing and Napoleon. The work has not yet gone far enough to determine the best pollinizers for cherries in this State.—*Annual Report of Director.*

AN IMMIGRATION POLICY

Any Plan for Restriction Must Take Account of Asia as Well as Europe—Percentage Basis the Best One for Limitation—Arrangements Must be Made to Americanize Those Who Come

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THE need of adequate and wise immigration and Americanization legislation is imperative. Now, while war suspends the tide of new-comers to our shores, is the time for enacting the new laws to regulate the coming of fresh aliens.

No one can foretell how large or small will be the immigration from the war-ravaged countries of Europe. One factor in the problem that is generally overlooked is this: Wages in America will be high after the war and demand for cheap labor will be urgent. Immigration companies and steamship lines will seek for fresh sources of cheap labor to bring to America. What is to prevent them from securing hundreds of thousands from West and North Africa, Egypt, Syria and Asia Minor?

Present laws afford no method of control either of the numbers or of the race types that may be admitted, if only they pass the physical tests now authorized. We have reason to expect a large immigration of peoples that will prove extremely difficult of Americanization.

We need, therefore, a comprehensive and constructive policy for the regulation of all immigration, a policy that is based on sound economic, eugenic, political and ethical principles, and a program worked out in detail for incorporating that policy into practice.

Such a policy, moreover, must take into consideration not merely the relations of America with Europe, Africa and West Asia, but also with China, Japan and India. The world has become so small and travel so easy that economic pressure and opportunity are now bringing all the races into inevitable contact and increasing intermixture. To avoid the disastrous consequences of such contacts and intermixtures, and to enable the United States not only to provide for her own prosperity, but also to make to the whole world her best contribution for human betterment, we need policies that are based upon justice and good will, no less than upon economic and eugenic considerations.

The following proposals are offered as a contribution to the discussion of these important matters.

The need of regulating immigration from Europe and West Asia is so well recognized that nothing further will be said upon it in this brief discussion. It is important, however, that Americans should realize that the present laws dealing with Japanese, Chinese and Hindoos are quite obsolete. They are not only obsolete; they are positively dangerous.

THE NEW ORIENT

New Japan has already acquired the mechanical instruments, the political, economic and industrial methods, and the science, education, ideas and ideals of occidental civilization. New China is rapidly following in the footsteps of Japan. Both are increasingly self-conscious and insistent on courteous treatment and observance of treaties. They are asking, with growing earnestness, for recognition on a basis of equality with nations of the West.

The great world-problem of the twentieth century is undoubtedly the problem of the contact of the East and the West. Whether it shall bring us weal or woe depends largely on the United States. Shall our oriental policy

be based on race pride, disdain and selfishness? Shall it be entirely devoid of sympathy? And shall we rely on brute force for carrying it through? Or shall we give justice, courtesy and a square deal, refusing to be stamped by ignorance, ill-founded suspicion and falsehood? Shall we "prepare" to maintain by our military might a policy of arrogant disregard of their needs and feelings, or shall we remove dangers of conflict by a policy of friendly consideration and genuine helpfulness?

The new Orient renders obsolete and dangerous our nineteenth century Asiatic policy. Let us now promptly adopt a new policy—one that will provide, on the one hand, for the just demands of the Pacific Coast States to be protected from a swamping Asiatic immigration; and yet that also provides on the other hand for full courtesy of treatment and for complete freedom from race discrimination which is inevitably regarded as humiliating. The new policy should provide for observance of the spirit no less than of the wording of our treaties, and be thus in harmony with the principles of good neighborliness.

THE NEW IMMIGRATION POLICY

All this means that we need comprehensive immigration legislation dealing with the entire question in such a way as to conserve American institutions, protect American labor from dangerous economic competition, and promote intelligent and enduring friendliness between America and all the nations, east and west, because free from differential race treatment.

Restriction of immigration has been widely demanded in recent years. Three times Congress has passed a literacy test immigration bill. Three times has it been vetoed. But even if it became law, would it suitably and adequately regulate immigration? Would it avail in maintaining a wholesome proportion between the aliens and the naturalized? Moreover, a literacy test law could not wisely be applied to Asiatics, for it would admit millions.

Do we not now need legislation, limiting immigration on a numerical basis? Should not the annual immigration be adapted to our economic conditions? And should not that limitation deal equally with all races? Should not our immigration legislation, moreover, also provide for the rapid education and Americanization of those who are admitted?

Such a policy and program constitutes one of the pressing needs of the times. Quite as important as military "preparedness" to resist attack is diplomatic and legislative "preparedness" to reduce tension and promote international friendship.

The following paragraphs present in barest outlines a constructive program for comprehensive immigration legislation:

1. The Control of Immigration.

Immigration from every land should be controlled, and, if excessive, it should be restricted. The principle of restriction should be applied equally to every land, and thus avoid differential race treatment.

2. Americanization the Principle of Control.

The proved capacity for genuine Americanization on the part of those already here from any land should be the measure for the further immigration of that people. Newcomers make their first contact with America through those who speak their own language. The Americanization, therefore, of newcomers from any land depends largely on the influence of those already here from that land. The number of newcomers annually admissible from any land, therefore, should be closely dependent on the number of those from that land who, having been here five years or more, have actually become American citizens. These know the language, customs and ideals of both peoples, ours and theirs.

America should admit as immigrants only so many aliens from any land as she can Americanize.

3. The Proposed Restriction Law.

Let, therefore, an immigration law be passed which provides that the maxi-

mum permissible annual immigration from any people shall be a definite per cent (say five) of the American-born children of foreign parents of that people plus the number of those from that same people who have already become naturalized citizens.

The grandchildren as a rule do not know their ancestral language, and therefore do not aid particularly in the Americanization of newcomers.

The permissible annual immigration from the respective peoples, as calculated from the census of 1910, is given in the tables of the Appendix. They show that in general there would be no restriction on immigration from North Europe. The reverse, however, would be the case for the countries of South Europe. The permissible immigration from China and Japan would be less than that which has been coming in recent years. (See Appendix.)

Provision should be also made for the protection of all newcomers from ruthless exploitation and for their distribution, employment and rapid Americanization. To aid in the accomplishment of these ends, the Federal Government should establish—

4. Bureau of Registration, Employment and Distribution

All aliens should register annually until they become American citizens, and should pay an annual registration fee, of say $10. We need to know who the aliens are and where they live, and they need to know that we know these facts about them. A system of registration could be worked out in connection with a National Employment Bureau as suggested by the late Prof. Henderson that would not involve police surveillance. This Bureau should be regarded as a method for friendly aid, not of hostile and suspicious control.

Plans, moreover, should also be developed for a system of distribution. This would not be difficult if a Federal Bureau of Distribution were established with an adequate capital fund and enabled by proper legislation to purchase by condemnation at fair prices agricultural lands fitted for settlement, now held by speculators. These should be sold to immigrant settlers on long mortgages and easy terms, and providing capital for initial outfit. Privileges of establishing homes upon relatively easy terms should be extended not only to immigrant aliens but to any applicants whether alien or American citizens.

5. A Bureau for the Education of Aliens

This Bureau should set standards, prepare text-books, promote the establishment of night schools by States, cities and towns—which might receive Federal subsidies—and hold examinations. The education and the examinations should be free. Provision should be made for the reduction of the registration fee by, say $1, for every examination passed. The education should be simple and practical, avoiding merely academic proficiency. Let there be six examinations, three in English and one each in the History of the American People, in the Methods of our Government, Local, State and Federal, and in the Ideals of Democracy. When all the examinations have been passed, there would still remain the annual registration fee of $4, so long as the individual chooses to remain an alien. There should also be—

6. New Regulations for the Bureau of Naturalization

Citizenship should be granted only to those who have passed the required examinations provided by the Bureau of Alien Education and have maintained good behavior during the five years of probationary residence. The naturalization ceremony might well take the form of a dignified welcome service—say on a single day in the year—the Fourth of July, with appropriate welcome orations, banners, badges and banquets.

7. Citizenship for All Who Qualify, Regardless of Race

Eligibility to naturalization should be based upon personal qualifications of intelligence, knowledge and character.

The mere fact of race should be neither a qualification nor a disqualification.

Such are the main outlines of the proposed Comprehensive and Constructive Program here offered for the solution of the entire immigration problem, Asiatic as well as European. For a more adequate understanding, however, of this general proposal we should consider—

8. A Few Additional Details

(*a*) No change should be made in the schedule for maximum immigration between the census periods. With each new census a new schedule should be prepared, but it should not go into operation automatically. Congress should reconsider the whole matter once in ten years upon receiving the figures based upon the new census, and decide either to adopt the new schedule or some new percentage rate, or possibly to continue the same schedule for another decade.

(*b*) Provision should be made for certain excepted classes. Government officials, travelers and students would, of course, be admitted outside of the fixed schedule figures. Aliens who have already resided in America and taken out their first papers, or who have passed all the required examinations, should, also, doubtless be admitted freely regardless of the schedule. Women and children under 14 years of age should also be included among the excepted classes. If thought important, unmarried women 25 years of age and over might be subject to the percentage rate. By providing for such exceptions the drastic features of the proposed plan would be largely, perhaps, wholly relieved.

(*c*) Should the restriction required by the 5 per cent plan be regarded as excessively severe, the per cent rate could be advanced. In any case it seems desirable that the 5 per cent restriction should be applied only to males 14 years of age and over, and to unmarried women 25 years of age and over.

(*d*) In order to provide for countries from which few have become American citizens, a minimum permissible annual immigration of, say 1,000, might be allowed, regardless of the percentage rate.

(*e*) Registration, with payment of the fee, might well be required only of male aliens 21 years of age and over. Since, however, it is highly desirable that immigrant women also should learn the English language, provision might be made that all alien women should register without payment of the fee and be given the privileges of education and of taking the examinations free of cost. This privilege might extend over a period of five years. After passing the examinations there should be no further requirement for registration. If, however, after five years the examinations have not been passed, then they should be required to pay a registration tax of six dollars annually, a reduction of one dollar being allowed for every examination passed.

(*f*) In order to meet special cases and exigencies, such as religious or political persecutions, war, famine or flood, provision might well be made to give special power to the Commissioner of Immigration in consultation with the Commissioner of Labor and one or two other specified high officials to order exceptional treatment.

(*g*) The proposed policy, if enacted into law, would put into the hands of Congress a flexible instrument for the continuous and exact regulation of immigration, adapting it from time to time to the economic conditions of the country.

(*h*) How the war is to influence future immigration is uncertain. Some anticipate an enormous increase, while others expect a decrease. Is it not important for Congress to take complete and exact control of the situation while the present lull is on and be able to determine what the maximum immigration shall be before we find ourselves overwhelmed with its magnitude? If the post bellum immigration should prove to be small, a law limiting it to figures proposed by this plan would not restrict it. If it should prove to be enormous we would be prepared to deal with it.

(*i*) An objection to the proposed plan is raised by some. It is urged that tens of thousands would suffer the hardship of deportation because of arrival after the maximum limit has been reached. Such a situation, however, could easily be avoided by a little care in the matter of administration. Provision could be made, for instance, that each of the transportation lines bringing immigrants from any particular land should agree with the immigration office upon the maximum number of immigrants that it may bring to America during the year, the sum total of these agreements being equal to the maximum permissible immigration from that particular land. There would then be no danger of deportation because of excessive immigration. The steamship lines, moreover, would see to it that their immigration accommodation would be continuously occupied throughout the year, avoiding thus a rush during the first two or three months of the year.

(*j*) A second objection is raised by some, namely, the difficulty of selecting the favored few in those countries where the restriction would be severe. This difficulty, however, would be completely obviated by the steamship companies themselves. Immigrants would secure passage in the order of their purchase of tickets; first come, first served.

(*k*) In order to alleviate hardship as far as possible, might not immigration inspection offices be established in the principal ports of departure, and provision be made that all immigration from specified regions should receive inspection at those offices alone, such inspection to be final?

Would not the above proposals for a comprehensive and constructive immigration policy coördinate, systematize and rationalize our entire procedure in dealing with immigration, and solve in a fundamental way its most perplexing difficulties? Such a policy would protect American labor from danger of sudden and excessive immigration from any land. It would promote the wholesome and rapid assimilation of all newcomers. It would regulate the rate of the coming of immigrants from any land by the proved capacity for Americanization of those from that land already here. It would keep the newcomers of each people always a minority of its Americanized citizens. It would be free from every trace of differential race treatment. Our relations with Japan and China would thus be right.

Such a policy, therefore, giving to every people the "most favored nation treatment," would maintain and deepen our international friendship on every side.

Criticism of this plan is invited. If the reader finds himself in harmony with this proposal a letter of endorsement would be appreciated.

APPENDIX

The statistical tables of this appendix give the actual immigration of the five years ending June 30, 1915, so classified as to show what the effect upon that immigration would have been if the proposed 5 per cent standard for its limitation had been in force. The basal figures here given have been especially prepared for the writer by the statistician of the United States Bureau of Immigration.

In classifying aliens the Immigration Bureau distinguishes between immigrants (who come for permanent residence here) and non-immigrants (who come for a transient stay). The 5 per cent restriction proposal as worked out in these statistics does not limit the entering of non-immigrants, of children or of women. It affects only males 14 years of age and over.

Column 6 gives the standards for the maximum permissible annual immigration of males from the various races and peoples according to the 5 per cent restriction policy advocated in this article. This column is derived from the census of 1910; the figure for each people is 5 per cent of the American born children of foreign parents of that people plus the number of those from that same people who have become naturalized citizens. This last item (the nat-

TABLES SHOWING HOW THE FIVE PER CENT RESTRICTION PROPOSAL WOULD HAVE AFFECTED IMMIGRATION FOR THE PERIOD 1911–1915

	Table I					Table II	
	Aliens actually admitted during the five years ending June 30, 1915; cf. Annual Reports of Immigration Bureau, Tables IV and VII B					The proposed 5 per cent standard	
	1	2	3	4	5	6	7
Race or people	Non-immigrants	Immigrants	Female immigrants 14 years and over	Male immigrants 14 years and over	Annual average of column 4	Maximum permissible annual immigration of males ([1])	Annual average of males who would have been excluded ([2])
1. African (black)	16,173	34,221	13,042	18,114	3,622	209	3,413
2. Armenian	786	26,384	3,346	21,180	4,236	444	3,792
3. Bohemian and Moravian	2,689	40,332	14,199	18,388	3,677	16,994	....
4. Bulgarian, Serbian and Montenegrin	6,301	48,556	3,873	42,506	8,501	5,601[4]	19,916[4]
5. Croatian and Slovenian	7,938	125,073	29,088	85,083	17,016	....	....
6. Chinese	12,090	9,760	1,212	7,778	1,555	1,106	449
7. Cuban	15,565	17,109	4,297	10,326	2,065	590	1,475
8. Dalmatian, Bosnian and Herzegovinian	920	18,046	2,169	15,185	3,037	[3]	....
9. Dutch and Flemish	16,426	58,545	15,893	30,816	6,163	12,956	....
10. East Indian	263	1,124	37	1,070	214	[3]	....
11. English	166,990	252,877	91,865	119,730	23,946	127,745	....
12. Finnish	6,387	45,453	16,423	24,956	4,991	5,038	....
13. French	27,595	87,968	30,525	41,636	8,327	47,735	....
14. German	79,920	313,279	109,081	148,634	29,726	333,581	....
15. Greek	10,690	168,299	15,833	145,859	29,171	886	28,285
16. Hebrew	17,719	437,696	150,083	186,402	37,280	37,342	....
17. Irish	49,317	168,592	75,491	81,220	16,244	201,491	....
18. Italian (North)	36,282	154,751	33,319	104,502	20,900	45,768[5]	72,568[5]
19. Italian (South)	96,051	825,250	175,281	537,181	107,436	....	....
20. Japanese	15,562	36,599	22,317	12,292	2,458	1,220	1,238
21. Korean	58	403	205	159	32	[3]	....
22. Lithuanian	2,697	79,974	28,442	44,766	8,953	4,360	3,593
23. Magyar	11,845	122,347	40,975	61,616	12,323	5,436	6,887
24. Mexican	23,462	75,821	20,179	36,752	7,350	8,648	....
25. Pacific Islander	76	33	11	20	4	[3]	....
26. Polish	26,631	462,696	151,604	260,008	52,001	49,212	2,789
27. Portuguese	4,702	44,461	12,274	24,809	4,961	3,788	1,173
28. Roumanian	4,038	52,361	8,836	40,320	8,064	676	7,388
29. Russian	15,789	142,167	16,255	119,513	23,902	2,203	21,699
30. Ruthenian (Russniak)	21,104	109,937	37,186	65,262	13,052	663	12,389
31. Scandinavian	56,621	176,513	58,573	102,701	20,520	102,095	....
32. Scotch	41,193	100,518	37,603	46,275	9,235	38,776	....
33. Slovak	7,153	101,815	33,385	53,849	10,769	6,831	3,938
34. Spanish	25,870	42,949	6,981	31,254	6,250	906	5,344
35. Spanish-American	9,268	7,069	1,764	4,237	847	128	719
36. Syrian	2,953	30,969	8,114	18,691	3,738	844	2,894
37. Turkish	436	7,235	370	6,672	1,334	58	1,276
38. Welsh	4,278	11,255	3,245	6,230	1,246	12,188	....
39. West Indian (except Cuba).	6,329	5,663	2,213	2,814	562	17	445
40. Others	2,009	15,728	1,174	13,954	2,790		
Totals	852,176	4,459,831	1,276,763	2,592,770	518,554		

[1] For the derivation of the figures given in this column see explanatory paragraph of Appendix.

[2] The figures of this column are secured by subtracting the figures of column 6 from those of column 5.

[3] No census data.

[4] Bulgarians, Croatians, etc., are combined in this column.

uralized citizens) was secured "by mathematical calculations based upon Tables XIII and XXXIII, pp. 975 and 1082, Vol. I of the Census Population Report for 1910." Subtracting the figures of column 6 from those of column 5 (the average annual number of males actually admitted) we secure column 7, showing the annual average number of males who would have been excluded had the 5 per cent limitation principle been in force.

The number of immigrant children admitted during the five years ending June 30, 1915, may be secured by subtracting the sum of the figures given in Table I, columns 3 and 4, from the corresponding figures given in column 2.

POINTS TO NOTICE

1. The proposals here advanced would have imposed more rigid restriction not only upon Japanese but also upon Chinese than is imposed by the present laws and arrangements.

2. The restriction upon Italians is particularly striking. But note the large disparity between Italian male and female immigrants.

3. The plan here proposed if in force would have imposed no restriction upon Hebrew immigration.

4. The average immigration from Europe for the past five years was, of course, seriously disturbed by the striking decrease for 1915 because of the war. Allowance must be made for this factor.

5. The restriction of the immigration of men will, of course, sooner or later affect that of women and children.

6. In column 6, the figure 1,000 should be substituted in each place where the 5% rate would allow an immigration less than this amount, in harmony with the proposal of paragraph (*d*) above.

7. The total annual average immigration of males from those countries whose actual immigration was less than their permissible maximum amounted to about 170,000 while the total permissible annual immigration of males from those countries that exceeded their permissible maximum amounted to about 136,000. If the immigration, therefore, of the past five years had been regulated by the policy set forth in this pamphlet, the average immigration of males from all countries would have been about 306,000 annually, instead of the average of 518,000 that actually were admitted.

A Hypothesis of Semi-sterility Confirmed

In accounts of semi-sterility ([1], [2], [3]), I stated in effect that the fertile F_2 plants from semi-sterile F_1 hybrids probably consisted of two classes KK and LL, such that intercrossing within the classes or back-crossing with the proper grandparent should give fertile plants, while crossing between the classes or back-crossing with the other grandparent should give perfectly half-sterile plants. This hypothesis has now been confirmed as regards back-crossing. Two completely fertile lines, descended from semi-sterile F_2, and one completely fertile F_2 plant were in the ordinary course of breeding back-crossed with the Florida velvet bean (*Stizolobium deeringianum*), one of their ascendants. Two (KK) plants have perfectly fertile progeny and one (LL) gave perfectly semi-sterile progeny, thus confirming the hypothesis. The Florida velvet bean has now been crossed with the Lyon, the Yokohama, and the China, with the production in each case of a completely semi-sterile first generation. Last year the cross of the Florida velvet with the fleshy-pod bean (*S. pachylobium*) was carried out, and yielded also a perfectly semi-sterile first generation.

JOHN BELLING.

[1]Belling, J. A study of semi-sterility. JOURNAL OF HEREDITY, Vol. v (1914).
[2]Belling, J. The mode of inheritance of semi-sterility. Zt. f. Abst. und Vererbungslehre, 1914.
[3]Belling, J. Inheritance of semi-sterility. Fla. Exp. Sta. Report for 1914-5.

PITTED EAR LOBES OF CONGENITAL ORIGIN

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Pits found at birth in the lobes of the ears. (Fig. 7.)

A young woman in my class in Physical Anthropology recently reported an unusual mark on the lobes of both her ears which she and her family believe is inherited.

The accompanying pictures show a well-marked pit in the lobe of her right ear and a less distinct pit in the lobe of the left ear.[1] These photographs are reproduced without retouching. The pits are in substantially the same place they would have been, had the ears been pierced for rings.

The history of the case is as follows, as is believed and told by the young woman's mother:

The mother lives in Minneapolis. She was born in Karlstad, province of Varmland, Sweden. Her ears were pierced when she was about 2 years old, and she wears ear rings. It was the custom for men in Karlstad to wear ear rings at the time this mother's father was young. In consequence, the maternal grandfather of the young woman had had his ears pierced, and wore ear rings throughout his life. He died in Sweden. It is the belief of the young

[1] Photos are by Dr. E. K. Strachan of the School of Chemistry, University of Minnesota.

woman's mother that all her ancestors, both men and women, for many generations, wore ear rings.

The young woman's father was born in Trasmarken, province of Varmland, Sweden. It was not the custom for men in his neighborhood to wear ear rings, so his ears were not pierced. He died in Minnesota.

The young woman in question was born in Minneapolis in 1894. When she was two weeks old the family physician asked the mother why she had pierced the baby's ears so soon. An immediate investigation showed that the lobes of both ears had holes through them. This baby had been constantly in the immediate care of its mother and maternal grandmother, and the mother now says, "I know positively that no one did or could come in and pierce my baby's ears." Neither woman (according to the statement of the mother today) had noticed the holes in the ears until the physician called their attention to them. The physician, who was a European educated Swede, now dead, and the mother, and the grandmother, who is also dead, considered at the time that the holes in the lobes were "natural" to the babe. The family has always held that opinion. It was not until the young woman was studying the subject of the "inheritance of acquired characters" that she ever thought of her ears as being of interest.

Today there is a pit on both sides of each ear lobe, although there is no hole through either lobe. No ear rings were ever worn in the ears. There are two other children living today in this family. Neither of them has ever had the ears pierced, and neither one has the pitted ear lobe.

A Manual of Mothercraft

THE MOTHERCRAFT MANUAL, by Mary L. Read, B.S., Director of the School of Mothercraft, New York City. Pp. 440, price $1.25 net. Boston, Little, Brown and Co., 1916.

Mothercraft is defined by Miss Read as "the skilful, practical doing of all that is involved in the nourishing and training of children in a sympathetic, happy, religious spirit. It is not merely the care of the little baby; that is a very small, though significant, part. Its practice is not dependent upon physical parenthood, but is part of the responsibility of every woman who has to do with children as teacher, nurse, friend or household associate." The very comprehensive book begins with the selection of a mate and founding a home, and extends almost to the period of adolescence of the children, and within this period it is difficult to think of any phase of mothercraft which is not treated in considerable and definite detail. The remarks on eugenics are scant but suggestive. The low price and all-inclusive character of the work should make it widely used.

Progress of Eugenics in England

The eighth annual report (1915-1916) of the Eugenics Education Society (London) shows that its work is going ahead steadily in spite of the war—which has, indeed, produced "signs of an awakening national conscience in the sphere of eugenics." The society has endeavored to reduce the infant mortality, to check the spread of venereal diseases in the army, and to get a recognition for the interests of eugenics in new plans of taxation, so as not to penalize parenthood on the part of the fit. Several special courses of lectures have been given. In addition to its income from membership fees, the society has a guarantee fund amounting to about $2,000 annually. Maj. Leonard Darwin has been re-elected president.

LINEBREEDING

RICHARD H. WOOD
Heathwood Farm, Lewiston, Mich.

Lodeski
- Hiawatha IV
  - Hiawatha III
    - Hiawatha II
      - Hiawatha
      - Jada
    - Selina......
      - Hiawatha
      - Rodie
  - Alda.........
    - Hiawatha
    - Luda
- Elva........
  - Halo........
    - Hiawatha II
    - Selina
  - Daisy........
    - Hiawatha
    - Bossie......
      - Hiawatha II
      - Norie

AN ILLUSTRATION OF LINEBREEDING

The animal Lodeski is linebred to Hiawatha. The blood of Hiawatha has been perpetuated and intensified. The only animals in the herd that do not carry Hiawatha blood are Jada, Rodie, Luda and Norie. But take notice that while Lodeski is strong in the blood of Hiawatha, she carries but a small percentage of the blood of Jada. She is not bred in line to that animal, but rather to her great grand sire Hiawatha. Mating Lodeski to any animal carrying Hiawatha blood will still be linebreeding with reference to him; his blood can be carried by either sire or dam and linebreeding continued. To make the matter more plain suppose that Jada is mated with a son of Rodie and the offspring is mated with a descendant of Luda and the offspring is then mated with Lodeska. Not one of these animals is related to Hiawatha, although they are related to each other and to Lodeski. The use of such offspring upon Lodeski would be inbreeding, to be sure, but it would not be linebreeding with reference to Hiawatha. This ought to illustrate that while linebreeding is always inbreeding there are many forms of inbreeding that are not linebreeding.

The theory of Mendelism is duly recognized by the writer, and he does not mean that the percentage of blood always indicates inheritance. His only aim is to bring about a better understanding of the meaning of certain terms or words used by breeders and experimenters.

THE term "linebreeding" is improperly used by many of the present day writers. It is often confused with "inbreeding." Even some of the editors of agricultural papers are using the two terms as though their meaning were the same. The proper use of a term is to express the idea that called for its original use. For many years prominent live stock breeders upon both continents have practiced inbreeding, which is any plan of mating in which sire and dam are what is called blood relations, in an undefined but fairly close degree. The number of combinations and permutations of inbreeding are almost beyond computing. One form of inbreeding is called "linebreeding." But many cases of inbreeding are not linebreeding.

Someone has said that linebreeding is a mild form of inbreeding, This is not always true. It may be a very intensive or close form of inbreeding.

The term linebreeding was used by the early breeders to cover only one plan of inbreeding. When one of the old time breeders found an animal, sire or dam, that possessed one or more characters that he especially desired to perpetuate, he bred that animal upon his own progeny or upon some animal closely related to him that resembled him in the desired points or characteristics. Such mating is the beginning of a system of linebreeding, and the offspring of such mating can be said to be linebred for that one generation. But to carry out a system of linebreeding so that future progeny can be

said to be linebred the results of each mating must be bred to animals closely related to the original sire or dam. One can readily see that animals can be closely inbred from generation to generation and still be carrying less and less of the blood of a certain ancestor, while by linebreeding the proportion of that blood can be constantly increased.

Felch's well-known chart of linebreeding is often misunderstood. Many see only the great number of combinations possible from one mating. The chart shows more than that: it shows how the blood of a certain pair of animals can be amalgamated. This is seen by following the central lines. But it also shows that by following a one-sided system the blood of either sire or dam can be increased and the tendency to transmit certain characteristics intensified. Breeding a colt back to his dam is inbreeding. It is also linebreeding with reference to the dam, but it is not linebreeding with reference to the sire. Now it would be easy to find plenty of animals related to the new colt and yet unrelated to the sire, and it is a gross error in such a case to say that linebreeding is the same as inbreeding. It is to be hoped that writers will continue to give these terms their true meaning, which will be done by using them as they were used by those who first coined them.

Whether the terms are used honestly and properly or ignorantly and fraudulently we can easily ascertain by asking the question: "To what animal is this animal linebred?" If the user of the term does not quite understand what it means he will hesitate before replying while if he is engaged in misrepresentation a glance at the written pedigree will show whether or not the blood of a certain animal shows all down the line and in every mating. Linebreeding is only one form of inbreeding.

A Biography of Luther Burbank

LUTHER BURBANK: HIS LIFE AND HIS WORKS, by Henry Smith Williams, M. D., L.L.D. Pp. 333, 40 illustrations, some of them in color. New York, Hearst International Library Co., Inc., 1915.

Mr. Burbank has not been wholly fortunate in his biographers, but Dr. Williams' well-made book is at least an advance over W. S. Harwood's amusing performance of 1907. It is entertainingly written, and can hardly fail to create in the layman an interest in plant breeding. If the layman then pursues his studies, he will quickly get rid of the false perspective and inadequate statements of the problems of plant breeding. No one, indeed, need hope to get a proper idea of genetics from the book, but he may get an interesting account of much remarkable work, and in the concluding chapters some sensible observations on eugenics, although the parallels between plants and men are too closely drawn. Many of the illustrations are admirable.

Some Sweet-Pea Hybrids

What are believed to be the first species-crosses on record of the sweet pea (*Lathyrus odoratus*) are described in the *Gardeners' Chronicle* (London, September 30), by B. T. P. Barker. The only successful one of many attempts was with *L. hirsutus*, which differs little from the sweet pea. The first-generation hybrids were weakly and somewhat intermediate between the two parents; the second, third and fourth generations showed a little segregation of characters, but not much. These hybrids seem to have little commercial value, but attempts are being made to use them as "bridging species" for wider crosses.

THE GREAT UNMARRIED

A Review

WE COUNSEL marriage strenuously with one breath, Walter M. Gallichan complains, and impose hindrances to practice with the next. He has therefore written a book urging that we counsel marriage still more strenuously, and that we at the same time remove some of these hindrances to practice.

In so doing, he has shown himself to be a constructive eugenicist. His statistics are sometimes unsound; but statistics are a small part of his book. The "authorities" he cites are not always authoritative; but his book does not depend on the citations of authority. He has written an eloquent plea for a more eugenic view of marriage; his plea is marked by restraint and delicacy of feeling, and he puts forward no wildly impracticable ideas. It is written in a spirit of sanity and upbuilding that deserves commendation.

Mr. Gallichan's analysis of the causes and extent of celibacy offers little that is new, and being English in origin, is not always applicable to conditions in the United States. He balances sympathetically the justifiable and unjustifiable reasons which lead men to remain unmarried: selfishness, the desire to get along in one's profession, the fear of supposed feminine extravagance, and incompetence—economic causes, in general. The enforced celibacy of women is the natural consequence of the celibacy of men; most women, he thinks, would marry if they had the opportunity.

This postponement or avoidance of marriage naturally brings many evils, but he has little patience for those who merely wish to suppress the symptoms of the disease without attacking the causes. "If some of the activity applied to the attempted suppression of sexual vice were devoted to making the path of sexual virtue less difficult, great triumphs for the moralist would ensue."

WHAT ARE THE REMEDIES?

But the widespread postponement of marriage, and the various evil consequences of it, are well-known to eugenicists, who will be most interested in Mr. Gallichan's answer to the question, "What are the remedies?" He first dismisses as wholly impracticable three that have been suggested: (1) polygamy, (2) free love, (3) taxation of bachelors. The latter proposal, he remarks, "is typical of the disposition to tinker with an abnormality instead of seeking down to its source and striving to annihilate it. The reformers take it for granted that the bachelor is an anti-social individual who selfishly abstains from marriage and parenthood. This is only true of a percentage of well-to-do single men. The larger proportion of bachelors are single through necessity, not from deliberate preference. Obviously it would be unjust to tax those who are already debarred, through economic reasons, from entering matrimony. Taxing the rich bachelor would not encourage him to marry. . . . The best way to diminish the number of bachelors is to adapt marriage to the present needs of the community by removing formidable hindrances to the altar."

The first hindrances which must be removed are the economic. He discusses:

(*a*) The necessity for a living wage.

(*b*) Cooperation or profit-sharing schemes.

(*c*) Development of the resources of the land—a "back to the land" movement.

(*d*) Maternity grants or other state aid for motherhood. He does not discuss this in detail, but his attitude in other portions of the book shows he

[1]The Great Unmarried, by Walter M. Gallichan. Pp. 225, price $2.25 net. New York, Frederick A. Stokes Company, 1916.

is fully alive to the dangers of indiscriminate aid, and realizes the need of quality, not quantity, in children.

(*e*) Communal, municipal, or group nurseries, which "might be adopted in particular cases, to meet the need of working people."

(*f*) The adoption of the system of dowries, as it is practiced in France: "the *dot* gives a sense of independence to brides and proves an assistance to the newly married pair at the outset of matrimony. . . . There is now in England some indication that the *dot* system is becoming a practice among those parents who purchase endowment for daughters by insurance."

(*g*) "Of the many factors militating against marriage and the reproduction of offspring in the vigor of life, exorbitant rents and the widespread and increasing house-famine rank among the most formidable and grave."

"We may now summarize the suggested economic remedies as (1) the raising of wages to a minimum standard for the adequate support of the parents and a moderate family; (2) provision of a large number of cheap and sanitary houses in town and country; (3) the encouragement of small farming and rural life; (4) the introduction of the endowment of daughters for marriage; (5) the granting of bonuses to parents who are willing to raise good-sized families."

Whether or not one thinks the suggested remedies would do what is expected of them, it must be admitted that they are not revolutionary in character. Mr. Gallichan remarks that others of the nations engaged in the Great War are considering the problem; that Russia has decided to permit the marriage of girls under 16, in special cases, and that Germany is considering "a vigorous government matrimonial policy [which will] encourage men to marry young and enable working women and girls to marry without giving up their occupation, perhaps by inaugurating 'half days' for working wives."

SOCIAL REMEDIES

The above supposed remedies could be adopted by the process of lawmaking; Mr. Gallichan points out, however, that public opinion must first be aroused. The "social remedies" are no less important, and must depend wholly on public opinion. Among them he enumerates:

1. More "temperance" in work. Too great a devotion to business is "inimical to love and to marriage in the best years of life. . . . We do not even recognize love as a finer passion than money greed. It is a kind of luxury, or pleasant pastime, for the sentimentally minded. Love is so undervalued as a source of happiness, a means of grace, and a completion of being, that many men would sooner work to keep a motor car than to marry."

2. A new valuation of love. We must study it and understand it; we must overcome our idea that it is not a proper subject for conversation; we must learn to value love as sacred, if marriage and parenthood are to attain true dignity in our minds.

3. The teaching of the proper kind of sex hygiene.

4. A simplification of life would be a great stimulus to marriage at the suitable age. "Slavish worship of acquisition and possession stands in the way of a realization of life."

5. Training of women in domestic economy and mothercraft. Girls should be educated for marriage as boys are trained for business.

6. Greater respect for the individuality of women, on the part of men, so that no woman shall shrink from marriage with the idea that it means a surrender of her personality and a state of servitude. Truer idea of sex-equality. This would include recognition by men that women are not necessarily creatures of inferior mentality.

7. "The fanatical respect for social caste is one of the checks upon marriage, especially among women. So long as the caste system is observed with fetichistic ardor, the woman of the 'gentlefolk' genus, who is out of sympathy with suitors of her own class, will always find the range of selection extremely restricted. Possibly in the remote future the aristocracy of character and intellect will be the only

recognized caste, and mere birth, without the prestige of virtue and wisdom, will count for nothing."

In short, "the social remedy for readjusting the tendency to defer marriage long after the attainment of the adult age, is the diffusion of healthier views of the conjugal relation, accompanied by a reconsideration of the essential question of pecuniary means." "Industrialism and commerce must be adjusted to life, and not permitted to kill all that constitutes living."

HIS VIEW OF US

Mr. Gallichan's remarks on a needed change in divorce laws apply more to England than to the United States. What he thinks of our own lawmakers is worth knowing:

"In the United States the attitude to the sex question is curiously variable. Some of the social views and legal enactments are sanely conceived and equitable, while others are monstrously ridiculous and futile. On one hand, we have such inept regulations as that which prohibits a pair of lovers from decorous fondling in the public parks; and on the other hand we find many instances of a breadth of rational opinion concerning sexual instruction for the young. There is the tyrannous Puritanism that bans scientific inquiry into the psychology of sex, and permits a post-office censorship of serious books in transit; and there is the growing interest in, and the encouragement of, research in the neglected department of sex-hygiene. There are wild measures for the suppression of vice, and entirely sane official inquiry into the causes, the conditions, and the prevention of prostitution. America affords instances of excessive prudery and of frank, seemly investigation. Books are banned in the United States; but some that are suppressed in England are sold openly in America.

"Divorce law in the United States, although by no means universally equal throughout all the States, is fairly humane and broad. Careless critics of marriage reform often point to America as the country of frequent and widespread divorce. The truth is entirely contrary to this assumption. Taking the whole of the population, divorces in America are not even 1%. It should be remembered that New England, the home of Puritanic morality, was the birthplace of reform in the matter of divorce. Freedom of divorce is not a factor of immorality."

To return to Mr. Gallichan's "social remedies," it will be observed that they are on the whole of the same general character as those that Americans, facing quite different problems to those of the Englishman, have urged. Mr. Gallichan feels that if those who have this attitude make it persistently known, they will win the day.

A PROPAGANDA OF MARRIAGE

"The propaganda of marriage must be well planned and the instruction graduated. Above all, the advantages of wedlock should be insistently urged, and the evils of celibacy and the counterfeit celibacy vividly illustrated. . . . The fine ideals of love and marriage, as presented in the highest forms of art, and in the biographies of the happily wedded, should be taught as history is taught in the schools."

"We have ardent crusaders against vice, but where are the propagandists of one of its antidotes, marriage? What publicist of note, what cleric, what statesman has suggested a campaign for the promotion of matrimony?"

"The true, intimate chronicle of an everyday married life has not been written. Here is a theme for genius; for only genius can divine and reveal the beauty, the pathos, and the wonder of the normal or the commonplace. A felicitous marriage has its comedy, its complexities, its element, too, of tragedy and grief, as well as its serenity and its fealty. Matrimony, whether the pair fare well or ill, is always a great adventure, a play of deep instincts and powerful emotions, a drama of two psyches. Every marriage provides a theme for the literary artist. No lives are free from enigmas.

"Art might be more often employed in the service of Hymen, in the laudation rather than the criticism and condemnation of marriage. It is well to use the

novel as a popular medium for the revelation of life; and works of fiction exposing the inequalities and the defects of conventional marriage are moral sermons in disguise. But wedded love is not only a poetic dream. It exists in spite of scepticism. Love in novels usually ends at the altar. Apparently the bulk of novelists cannot conceive that our interest may be held by a recital of conjugal love."

The church has also failed to live up to its possibilities in its attitude toward matrimony, Mr. Gallichan believes. It should share with art the task of setting high standards and helping men and women to reach them.

SOUND ETHICAL TEACHING

"The historic crusade with impurity has failed, because purity, in its true sense, has not been defined and incessantly promulgated as the happier mode of living. A child is wont to question why he should obey the counsels of his parents; and the wise parent will endeavor to convince the child that obedience of the moral rule brings satisfaction, whereas infringement brings penalties and unhappiness. Every intelligent mind asks the question, 'Why should I act in this way, and refrain from acting in that way?' Positive ethical teaching essays to provide a convincing answer to such rational inquiry. Moralists should endeavor, therefore, to convince that the path of purity, or the state of marriage, though not immune from difficulties and trials, is less perilous and more tolerable in the long run than the path of impurity, or the state of libertinism, and that virtue is not always painfully laborious. This might be proved on utilitarian grounds. There is evidence enough that, as most persons marry, and that many marry more than once, the majority find at least a fairly high degree of felicity in wedded life. I have shown that the married live longer than the celibate; that they preserve higher health of body and mind, and are less subject to neuroses and psychoses; and that conjugality develops restraints and virtues that tend to the well-being of society.

"All counsels of sex-morality must be savored with practical reason, and made positive and explicit. It is futile to offer marriage as an alternative to a supportable single life, or as a substitute for pseudo-celibacy, unless marriage is represented as more alluring than these conditions. Wedlock should be regarded as a truly great and noble social sacrament, and not as a way of escape from sin, a life of material comfort, or a mere custom of respectability. Esteem for marriage must be inculcated in order to counteract disesteem and reluctance to marry. The potential worth of marriage is only recognized by those who think clearly and deeply upon the subject. Yet the mass of men and women who enter lightly into this momentous partnership are profoundly ignorant concerning its character and the innermost feelings of one another. This may seem extravagant to all except those who have devoted close inquiry and observation. There are still millions of people who think that instinct, or play of sex-attraction, is the beginning and the end and the totality of love and marriage, and that if we 'follow our instincts we cannot go far wrong in the realm of Eros.' No greater fallacy exists. Is there a sane man who relies upon his 'instincts' in business affairs?"

NEED OF KNOWLEDGE

"Men are not taught to understand women, and women are not taught to understand men. Without even the most rudimentary knowledge of comparative sexual physiology and psychology, how can the sexes hope to understand each other, and to live harmoniously, morally, and sanely, in wedlock? Many men know more of the psychology of the horse than of woman. A woman who drives a motor-car has at least some knowledge of its mechanism; but many women who take husbands for life know nothing whatever of masculine organization."

"We fall in love instinctively; but we cannot instinctively alone make a success of marriage and the passing on of the flame of life to our children."

"The promotion of marriage in early

adult life, as a part of social hygiene, must begin with a new canonization of marriage. This is the task equally of the fervent poet and the scientific thinker, whose respective labors for humanity are never at variance in essentials. . . . The sentiment for marriage can be deepened by a rational understanding of the passion that attracts and unites the sexes. We need an apotheosis of conjugal love as a basis for a new appreciation of marriage. Reverence for love should be fostered from the outset of the adolescent period by parents and pedagogues. The spiritual import and the beauty of the love of the sexes should be revealed, and a sense of worship instilled in young minds."

"From rude, primitive sexual pairing there has grown a supremely entrancing and tender idyllism that is the most potent of all spiritualities and a strange miracle of daily life. The true votary and venerator of marriage is the man or the woman who strives through knowledge to elevate marriage, and to make that state holy and exemplary."

The Fundamental Work on Measurement of Intelligence

THE DEVELOPMENT OF INTELLIGENCE IN CHILDREN, by Alfred Binet, D. Sc., and Th. Simon, M.D. Translated by Elizabeth S. Kite. Pp. 336. Price $2.00. Publications of the Training School at Vineland, N. J., Department of Research, No. 11, May, 1916.

THE INTELLIGENCE OF THE FEEBLE-MINDED, by Alfred Binet, Sc.D. and Th. Simon, M.D. Translated by Elizabeth S. Kite. Publications of the Department of Research, the Training School at Vineland, N. J., No. 12, June, 1916. Pp. 328. Price $2.00.

The Training School has done a real service by publishing these two volumes, which contain a translated collection of practically everything that Drs. Binet and Simon wrote on the measurement of intelligence. The first volume contains a complete explanation of the scale in its various stages of evolution; the second shows the operation of the scale in the hands of its authors as they used it in the study of the feebleminded, dements, and speech defects.

The Binet-Simon tests are so familiar now that it is hard to realize that the first publication on them dates back only to 1905, and that it was several years later that they were first heard of in America, when Dr. H. H. Goddard, who contributes an introduction to the first of the above volumes, had made use of them in his own work with successful results. Many of the criticisms since made would never have been made if the complete work of Binet and Simon had been known, and the present publications should serve to place the measurement of intelligence on an even more solid foundation than it at present has.

Mental Effects of Inbreeding in Rats

Albino rats inbred for a dozen generations have been tested at the Harvard Psychological Laboratory by Mrs. Ada W. Yerkes, with a view to finding whether they differ mentally from rats that are not inbred. They were studied in a maze, and the distances they traveled and the time they required to find their way through were noted. The conclusions presented in the *Journal of Animal Behavior* (Vol. vi, No. 4) show, in general, a little more slowness in learning on the part of the inbred rats. "This slowness seems chiefly to have been due to a greater timidity and a greater susceptibility to environmental conditions." In some tests, however, the inbred rats excelled. The study does not, of course, show that inbreeding *necessarily* produces any mental or physical inferiority. If there were inheritable factors for timidity, the inbreeding would intensify them and distribute them to all the rats, which might result in such conditions as Mrs. Yerkes found.

EXCEPTIONAL FECUNDITY AND LONGEVITY

HENRY M. JONES, *Lexington, Ky.*

THE picture herewith presented and the history of the subject should be of special interest to breeders of horses. It is an impressive lesson to young breeders that before selecting breeding stock a thorough historical knowledge of the family is imperative; that no animal can found a great family that does not live a long life and produce many young; that fecundity and longevity are racial characters, therefore inheritable, though in varying degree.

The subject of this sketch is the chestnut mare Mantua Maker by Red Wilkes 1749, dam Milliner by Harold 413, foaled May 22, 1891, and now 25 years of age. The foal is a bay filly foaled July 22, 1916, by General Watts (3) 2:06¾ and is the twentieth foal of her dam, each of which has come by single birth. The complete list follows:

June 3, 1895, ch f Junie Fleetwood by Simmons.
June 4, 1896, ch c Wanamaker by Simmons.
June 2, 1897, b c The Major 2:13¾ by Dr. Hooker.
June 10, 1898, b f Ruth Paddock by Dr. Hooker.
Not bred in 1898.
April 22, 1900, b c Richmond by Dr. Hooker.
April 11, 1901, b f Summer Morn by Electric Bell.
March 27, 1902, b c Wiltondale 2:20¼ by Adbell.
April 19, 1903, ch f Kentucky Girl by Constantine.
April 26, 1904, b f Priscilla Bond 2:24¼ by The Bondsman.
1905 missed to Prodigal.
March 25, 1906, b c De Soto 2:27¼ by The Bondsman.
March 22, 1907, b f Merrie Todd 2:23¼ by Todd.
April 27, 1908, b c El Vivillo 2:14¼ by Libretto.
March 31, 1909, ch f Rosanante 2:22¼ by Libretto.
March 26, 1910, ch c Don Jaime 2:20¼ by Libretto.
March 26, 1911, ch f Ruth Coleman 2:17¼ by San Francisco.
April 11, 1912, ch f Modiste by General Watts.
April 4, 1913, ch f Clara Coleman 2:24¼ by San Francisco.
April 29, 1914, ch f Mistle Thrush 2:19¼ by Axworthy.
June 4, 1915, b f Mary Frances Gay by General Watts.
July 22, 1916, b f .... by General Watts.

There is so much of interest in a thorough study of this mare's history and record that minute detail does not become tiresome:

1. An exceptionally high fecundity.
2. Correlation of fecundity and longevity.
3. Inheritance of both characters.
4. Correlation of œstrus and fecundity.
5. Effect of environment upon fecundity.

Available records do not show another trotting bred mare that has produced twenty foals. She was bred first when 3 years old and produced four consecutive foals, each of which came in the month of June. In 1898 she was not bred, it being desirable to have the foals come earlier. She then produced five consecutive foals and in 1905 missed to the cover of Prodigal. These foals came each year in the months of March and April. Since this she has produced eleven consecutive foals, each of which came in the months of March and April except the last two, one of which came in June, the other in July, the result of having broken service in each of the last two years, at that most critical of all periods, the seventh and eighth week. Prior to this she had never broken service since foaling. She has been again bred and as her physical condition is most excellent there is every reason to hope that she will produce other foals. The writer defines high fecundity as the ability to carry a large number of fœtuses to successful parturition and rear the foal to six months of age. This would seem the highest standard by which to judge.

MANTUA MAKER AND HER TWENTIETH FOAL

No other case has been found on record, of a trotting bred mare producing twenty foals; but Mantua Maker, above shown, appears likely to produce several more before her career of usefulness is ended. At the present time she is 25 years old. She was bred and has been owned throughout her entire career by Henry M. Jones, who has therefore been able to keep full data concerning her and her progeny. She comes of a fecund strain, and appears to have transmitted this valuable quality to her own offspring. Such strains are of great value to the livestock industry, and every breeder should try to find them and utilize them. (Fig. 8.)

She has reached this standard with eighteen of the twenty foals, the foal of 1912 having died, by an accident, when seven days old, and the last one has not yet reached the age.

The records show that the greatest trotting stallions lived from twenty-three to thirty-four years. While the records are not so accurate on mares, still the very greatest of them have lived long lives.

That this mare inherited longevity and fecundity is proved by the records. Her sire, Red Wilkes, died at 30 and sired 178 with standard records. His sons sired 1,037 and his daughters produced 312. Her grandsire, George Wilkes, died at 26, sired 83 standard performers; his sons sired 3,204 and daughters produced 209. Her great grandsire, Hambletonian, died at 37 after siring 40 standard performers; his sons sired 1,717, while his daughters produced 119. His sire, Abdallah, lived to be 31. Harold 413, sire of her dam, died at 29; and her fifth dam, Black Rose, has more than 2,700 descendants.

These facts are substantial proof that she inherited longevity and fecundity and it is further evidenced by the fact that these characters have been transmitted to her offspring, as the writer still owns her first two foals, which are hale and hearty at 21 and 20 respectively, and knows positively that eighteen of her twenty foals are now living. Her first foal, Junie Fleetwood, at the age of 16 had produced twelve foals, when pathological conditions arising at the birth of twins put an untimely end to her breeding career. Her granddaughter, Solferino, has produced seven foals and is now 11 years old and in the height of her breeding career.

The correlation of œstrus and lactation with fecundity has been carefully studied by the writer during thirty-five years experience in breeding horses. Indubitable evidence has been found that mares above the average in fecundity have a prolonged œstrum and highly developed mammary glands. This mare had the first œstrum when eight months old, which lasted six days and has never been of shorter duration but has sometimes lasted ten days. The mammary glands are so highly developed that 1 gallon of milk has been taken from her when weaning a foal. These characters have been transmitted to her daughter and by her to the granddaughters.

INFLUENCE OF ENVIRONMENT

Without entering into a discussion of the effect of environment upon the germ cell, we may say that the fullest expression of fecundity in this case is due in a great measure to environment. She has been given a wide range on blue grass land, underlaid by Trenton limestone, and fed upon grains produced by the same lands, so rich in phosphates. She has never been permitted to become thin in flesh and has had a roomy, well-ventilated box in winter. Her teeth have been dressed once each year and when foaling she has had the same care that would be given a mother in a maternity hospital. A practical experience of many years aided by dissection of subjects of various ages and physical condition has convinced the writer that the 40% of all mares bred that fail to produce foals can be materially reduced by impressing upon breeders the effect of environment upon the germ cell.

ALL BREEDERS SHOULD KEEP RECORDS

The unusual record of Mantua Maker as a producer carries a valuable lesson for all livestock breeders. A mare which can fulfil her obligation to posterity year by year as this mare has done, and at the same time keep the good health and sweet, benign disposition which her photograph shows, deserves something of the same respectful homage which all true men pay to the noble human mother surrounded by a troop of sturdy sons and daughters.

Livestock breeders will do well to hold the producing females as long as they produce. Fecundity is unquestionably inherited, and while it is not manifested so emphatically in the case of mares as in other farm animals, it is one of the powerful factors which the breeder has at his command. Simple produce records can be kept by every farmer and breeder, and will soon show which are the best producing individuals and which the most productive strains in the herd. By weeding out the non-producers, the factor of fecundity can be increased in the herd and its efficiency greatly augmented.

It would be interesting to know of other cases of high productiveness like that of Mantua Maker.

GEO. M. ROMMEL,
Secretary, American Genetic Association.

The Transmission of Rabies

Under the misleading title of "Studies on the Heredity of Rabies," Daniel Konradi describes in the *Annales de l'Institut Pasteur*, XXX, 33–48, his researches at the Institute of Pathology and General Therapeutics at Kologsvár, Hungary. It appears from a summary in the *International Bulletin of Agriculture* that rabies is transmitted by the mother to the fetus, but is attenuated in the process. Experiments are cited with dogs, rabbits and guinea-pigs; the latter are the most susceptible. Such a transmission is not inheritance, and much confusion has been caused in the study of heredity in the past, because of carelessness in ruling out cases of transmission to embryo from the mother.

HARVARD AND YALE BIRTH RATES

Graduates of Men's Colleges Do Not Make Satisfactory Showing, But Are Yet 50 to 100% Ahead of Graduates of Women's Colleges

THE inadequate marriage and birth rates of the graduates of the great women's colleges of the United States has often been pointed out by eugenicists. In many cases the apologists of the women's colleges have replied that these rates merely reflected the situation of the class from which college girls come, and charged that the graduates of the large men's colleges of the East would be found to have an equally bad showing. It was more than once alleged that the men, not the women, were to be blamed for the race suicide of this educated class.

Until now, there have been no adequate studies of the marriage and birth-rates of the large universities for men in the eastern United States. Dr. John C. Phillips has met the need by a very careful study of the figures of forty years at Yale and Harvard. He shows that their graduates marry in at least 50% more cases than do the graduates of the large women's colleges and, what is still more important, that the number of children per graduate is from 50% to 100% greater.

Dr. Phillips has published[1] an account of his research, which is given slightly condensed, herewith:

"My attention was called to college birth rate by reading the various papers in the JOURNAL OF HEREDITY on 'Race Suicide,' and the birth rate of the graduates of women's colleges. There did not seem to be any data of the same sort for the larger men's colleges, and I was particularly interested to see whether the rate had changed in recent years. The only available source from which to extract this information for Harvard University was the class reports. Harvard and Yale are here considered in the same way. In the case of Harvard the reports became fairly trustworthy for the Class of 1853, and for Yale they were usable back to the Class of 1850. I did not attempt to record births later than the Class of 1890, for the twenty-five year report of this class was just published at the time this work was done (summer of 1915), and earlier class reports are of little interest where the total number of children is sought for.

"All the figures involved in making up the final averages are based on class reports. All the available reports of every class have been tabulated and each name checked up on each report. Only those men whose records were fragmentary were left out, and this omission has the following tendency. It vitiates the two divisions, 'Children Born per Graduate' and 'Children Surviving per Graduate.' The effect is to lower slightly both these figures, for a few graduates with no history or only partial history appear here as having no children. This was necessary in order to get a true index of the birth rate of married graduates, but, as will be seen later on, the error is extremely small except in the first decade of Harvard records. It does not affect at all the columns 'Children Born per Married Graduate' and 'Children Surviving per Married Graduate.' These last are the items which interest us most, because the percentage of graduates who have married is a nearly constant one in the forty years included in this study.

"It is only necessary here to summarize the work in terms of decade averages for each college, and I have attempted to answer the following questions: What per cent of graduates of Harvard and Yale marry? How long after graduation do they marry, and has this interval changed? How many children does each married graduate

[1] In the Harvard *Graduates' Magazine*, XXV, No. 97, pp. 25–34, September, 1916.

have, and how much has this number diminished in the forty years under consideration? What per cent of marriages are childless?

CRITICISM OF DATA

"I now wish to criticize the data about to be presented. The column 'Average Number of Graduates' is based on the total number of graduates for each class, whether or not adequate future family history was available. The next columns, 'Average Number Married,' and 'Per Cent Married,' are based on the total number known to be married for each class. It is a little under the correct figure, because some of the lost men may have been married: but the error is very small except for the first decade for Harvard, classes 1853-60. In this decade 20.7% of the names were thrown out, injuring to a considerable extent the records for this period. In the next decade only 1.2% of the total names were found wanting; in the next 3.2% and in the last only 1.9%. Thus the total average error is very small. The Yale reports are even more reliable, but the percentage of 'lost' men has not been figured for Yale college.

"The next column represents the

TABLE I.—*Harvard.*

Decade	Average No. of graduates per class	Average No. married	Per cent married	Interval in years between graduation and marriage	Average No. of children born	Average No. of children per capita per married graduate	Average No. per capita per graduate	Average No. of children surviving	Average No. per capita per married graduate	Per capita per graduate	Average No. of childless marriages	Per cent of childless marriages
1851-60 Average of 6 years	90.8	49.2	.68	8.9	151.8	3.13	1.68	122.5	2.52	1.36	4.3	7.8
1861-70	101.9	77.3	.76	8.5	203.2	2.62	1.98	173.3	2.24	1.69	14.2	18.6
1871-80	157.5	115.4	.75	9.0	256.4	2.23	1.63	229.8	2.0	1.46	25.9	22.5
1881-90	248.	183.	.76	8.3	372.3	2.06	1.55	345.8	1.91	1.44	43.6	23.4
Grand average.	149.5	106.2	.74	8.7	245.9	2.51	1.71	217.8	2.17	1.49	......	......

TABLE II.—*Yale.*

Decade	Average No. of graduates per class	Average No. married	Per cent married	Interval in years between graduation and marriage	Average No. of children born	Average No. of children per capita per married graduate	Average No. per capita per graduate	Average No. of children surviving	Average No. per capita per married graduate	Per capita per graduate	Average No. of childless marriages	Per cent of childless marriages
1850-59 Average of 9 years	98.	75.	.78	7.5	247.1	3.32	2.53	196.1	2.64	2.0	10.5	14.3
1861-70	107.6	86.4	.81	7.8	233.6	2.69	2.16	197.8	2.28	1.83	16.4	19.1
1871-80	120.5	94.5	.79	8.5	211.9	2.23	1.75	181.9	1.92	1.51	20.3	21.7
1881-90	135.9	101.7	.75	8.2	207.6	2.04	1.53	189.8	1.87	1.40	21.3	21.0
Grand average.	115.5	89.4	.78	8.	225.1	2.57	1.99	191.4	2.18	1.69	......	......

interval in years and fractions of years between graduation and marriage. This is strictly a true figure, but it is only of relative interest. If we do not know the age at graduation, we do not know the age at marriage, and this is of particular interest in determining whether marriage has been postponed, and if so, how much. To answer this I have computed age at graduation at Harvard for two five-year periods, 1861-65 and 1886-90. For the first period the age is 21.8 years and for the last 22.8 years, a difference of one year. We can say then, since the interval between graduation and marriage has been a nearly constant one for 40 years, that the graduates married only one year later during the latter part of the period than during the earlier part. Strictly speaking, the age has increased from a little over 30 years to just about 31 years. This was a rather unexpected result, for it is commonly supposed that the age of marriage of professional men has advanced very much. Hankins, however, showed[2] that our native population from native parents marry earlier now than they used to. The uncharted period since the Class of 1890 may show a slightly greater age at marriage, but it is unlikely that there will be a marked change.

"The 'Average Number of Children Born per Capita per Married Graduate' is the next column, and this is very close to a perfect figure, because it is based only on those individuals who had a clear record, and there were not enough names discarded to vitiate the result.

"The 'Average Number of Children per Capita per Graduate' is a true index, except that it is slightly under the real figure. It is obtained by dividing the total number of children born by the total number of graduates for each class and decade.

SURVIVING CHILDREN

"The next three columns have to do with surviving children. They represent the children who grew up to at least several years of age, and in most cases escaped infant mortality. These figures are based on the children surviving at the last report for the class in question. The twenty-fifth report is in all cases the earliest report consulted. For the four decades at Harvard we have latest reports averaging as follows: First decade, 48 years; second decade, 43.7 years; third decade, 32 years; fourth decade, 26 years.

"The question arose at this point: How old were the children of graduates at the time of the twenty-fifth year class report? To answer this only one period, 1886–90 for Harvard, was computed. The average was found to be 13.1 years, showing that most of the children were past the dangers of the first five years of infancy at the time of the twenty-fifth year class report, and liable only to the much lower death-rate of advanced childhood. Also it may be noted that the twenty-fifth year report includes very nearly all the children born to the class. I wrote, however, to several class secretaries and it appears from these letters that only thirty-five children have been born to the classes 1881, 1882, 1889 and 1890 since their twenty-fifth year reports. This is only about 2% of the total born to these classes before the twenty-fifth year report, so that we can safely accept all twenty-fifth year reports, where this is necessary.

"The last two columns show the average number of childless marriages in each class, for each decade, and also the per cent of childless marriages in each decade. The figures will be found inaccurate for the first decade of Harvard graduates. All the others are reliable.

"The mass of data from which this report is drawn would make a large book. In working it up, 5,618 names were considered for Harvard and 4,522 for Yale. I have, therefore, thought it best to give only two final tables representing all the figures just considered, but showing only grand averages for the four decades between the classes of 1850 and 1890 for each college. There does not appear to be anything in the

[2] Journal of Heredity (1914), Vol. v, pp. 361–7.

yearly tables which does not show just as well in these decade tables."

YALE SURPASSES HARVARD

"It is scarcely necessary to call attention to these two tables; the falling birth rate is shown in all four columns where children are considered. Roughly, the number of children born per capita per married graduate has fallen from about 3.25 in the first decade to 2.50 in the last decade. The per cent of graduates marrying has remained about the same for forty years, and is a trifle higher for Yale; but the low figure, 68% for the first decade of Harvard, is probably due to faulty records, and must not be taken as significant.

"The next most interesting figure is the 'Children Surviving per Capita per Graduate.' This has fallen from over 2.50 to about 1.9. The per cent of childless marriages increased very markedly during the first two decades and held nearly level for the last two decades. For the last decade at Yale it has even dropped slightly, an encouraging sign. It is worthy of note that the number of children born to Yale graduates is almost constantly a trifle higher than that for Harvard, while the number of childless marriages is slightly less.

"Sprague[3] calculated that among American stock of the East the families must average 3.7 children 'for every mother who demonstrates any ability to bear offspring.' According to him every married woman bearing children must bring three to a marriageable age. He says that 15% of the stock he studied (New England) did not marry, or married too late, and that 20% of marriages produced no children. We have seen that 22 to 25% of Harvard and Yale graduates never marry, and that 19 to 23% of marriages are infertile; therefore, on Sprague's basis every married graduate having children must average a little more than three surviving children to perpetuate the stock.

"It is not my purpose here to suggest reforms or to analyze causes. I think every one in every walk of life will agree that the college graduate should at least perpetuate himself. Many of us disagree as to the eugenic ideal, for there is no single ideal possible, but all must admit that college men are at least fair samples of American manhood. The causes of the great decline in birth rate are almost world-wide, and they concern the economist, the psychologist, and the physician. Reform must come from within, not from without, and it will be brought about by a sterner sense of duty and a realization that the vain stampede after pleasure for pleasure's sake is leading us only to restlessness and discontent.

"Before concluding it will be well to compare the results of this study with the only investigation which gives us any real light upon the birth rate of the old American stock. I refer to the 'Report of the Immigration Commission,' Vol. 28. Here are a few of the facts touching on birth rate of Americans.

"Among American women under 45 years of age who had been married ten to nineteen years, 13.1% were sterile (childless): in Rhode Island, 17.5 to 19.4%; in rural Minnesota, 5.1%; and in the city of Minneapolis, 12.7%.

"Considering the number of children among this category of married American women, we find table III based on nearly 16,000 individuals from various sample districts.

"According to the 'Report of the Immigration Commission' native American stock cannot be holding its own in the East or in the cities of the Middle West. In the rural districts of the Middle West the women have just one more child each than in the urban districts, and this rural stock may be said to be a little more than holding its own. The birth rate in the South is supposed to be much higher.

"In Massachusetts the State report, *Births, Deaths, and Marriages*, for the twenty-five years ending 1911, shows us that the deaths among the native-born population exceeded the births among the native-born by nearly 270,000.

[3] JOURNAL OF HEREDITY, Vol. vi (1915), pp. 158–62.

During the same period the total births in families having foreign-born parents exceeded the total deaths by nearly 527,000. Comment is unnecessary.

TABLE III.—*Children of American-born Women of 45 Years or under, Married Ten to Nineteen Years. (Second Decade of Married Life.)*

	Rhode Island	City of Minneapolis	City of Cleveland	Rural Ohio	Rural Minnesota	Whole Area
Number of children	2.7	2.4	2.4	3.4	3.4	2.7

"The birth rate of college women is quite the most pathetic spectacle of all. Johnson and Stutzmann showed[4] that for Wellesley College, period 1879–88, only about half the graduates married and that the mothers had only 1.56 children each. Per graduate there was but .86 of a child each. Among the honor girls (Durant and Wellesley scholarships) those that married had about half this number of children, or just about half a child each!

"It is the writer's hope that these pages may fall among some readers who will take serious thought of the lesson they teach. Each generation has new duties and new distractions, but amidst the whirl of modernism let us not forget the oldest duty of all, that of the fathers and mothers of America in their care for the future of their country and the ideals of their race."

Prosperity and Eugenics

As people become more prosperous, there is a general tendency for their birth-rate to decrease. Now it is well for a nation that its people should have a reasonable amount of material comfort; but it is ill for a nation if their material success, which in itself is usually an evidence of some ability, leads to race suicide. The balance of these factors, therefore, gives justification to a question that at first sight seems paradoxical: "From the standpoint of eugenics, is it dangerous for the nation that its citizens should be morally and socially uplifted?"

The Berlin Race Hygiene Society has been asking this question for some time, but without getting an answer that balanced the advantages and disadvantages in a satisfactory way. Five years ago it offered a prize for the best essay on the subject, and a number of papers were sent in, but none was considered of any merit, save one on the Jews by Dr. Felix A. Theilhaber; and as the author later withdrew this paper, the prize was never awarded. Dr. Theilhaber reworked his contribution into two books: "Das sterile Berlin" (Berlin, 1913, Marquard), and "Der Untergang der deutschen Juden" (München, 1911, Reinhardt). The Berlin society has now renewed its prize offer and has received a dozen or more papers; a member of the American Genetic Association, who has examined these papers, observes that none of them appears noteworthy. The contest has not yet been closed.

Plan to Propagate Wild Game

A group of Chicago men is buying 10,880 acres of land in Wisconsin for a game farm, according to a letter from A. B. Hulit, secretary of the American Wild-Life Association, 175 Jackson Blvd., Chicago. The plan is to propagate all sorts of animals suited to that climate, such as elk, deer, moose, caribou, bison, and smaller fur-bearing animals, as well as some birds. The work of the American Wild-Life Association is described as (1) arousing public sentiment for the better protection of wild life; (2) cultivating among school children and others a better knowledge of the habits of birds and animals; (3) formation of cooperating State and local organizations; (4) securing protective legislation; (5) maintaining a bureau of information. Samuel Evans (of the Wallace Evans Game Farm, St. Charles, Ill.) is president.

[4] JOURNAL OF HEREDITY, Vol. vi (1915), pp. 250–3.

ASSOCIATION'S ANNUAL MEETING

THE American Genetic Association will hold its thirteenth annual meeting in New York City, December 26–30, in connection with the American Association for the Advancement of Science. All sessions will be held at Columbia University.

The full program, with the time and place of all sessions, will be issued about December 15, and may be obtained by application to the secretary, 511 Eleventh Street N.W., Washington, D. C.; or after Christmas at the headquarters of the A. G. A. in New York, Hotel McAlpine; or at the New York headquarters of the A. A. A. S., Hotel Belmont.

The opening session will be on Tuesday afternoon, December 26, at 2.30 p. m. The title of the presidential address is "The Importance of Photographs in Presenting Genetic Discoveries." A motion picture entitled "How Life Begins," produced by George E. Stone, of the University of California, in collaboration with Dr. J. A. Long, will be shown through the courtesy of the Exhibitor's Booking Agency. It is said to be the most successful film yet produced, in showing the processes of reproduction and embryology.

Sessions will be held, probably by sections, both morning and afternoon of Wednesday, December 27. A section meeting may be held Thursday morning, December 28. Any other meetings will be joint ones, which will not conflict with other biological societies.

As all the hotels of New York City are certain to be crowded, members who desire reservations should make them at once.

The following titles of papers have already been submitted:

W. S. Anderson, Lexington, Ky.: Some difficulties in breeding blooded stock.

E. E. Barker, Ithaca, N. Y.: The Present status of instruction in genetics.

Roswell H. Johnson, Pittsburgh, Pa.: The eugenic aspect of sexual immorality.

D. F. Jones, New Haven, Conn.: The effect of heterozygosis upon the time of maturity.

J. H. Kempton, Washington, D. C.: The effects of selection on aleurone color in maize.

E. W. Moore, Ithaca, N. Y.: Studies in self-sterility.

Robert T. Morris, New York City: Notes on the hybridizing of nut trees.

J. B. Norton, Washington, D. C.: Asparagus breeding.

F. H. Pike, New York City: The biological significance of death.

Mary L. Read, New York City: Eugenics and the education of young women.

A. D. Shamel, Riverside, Cal.: Bud variation and selection in lemons.

Robert J. Sprague, Amherst, Mass.: The constructive aspect of birth control.

Adolph E. Waller, Columbus, Ohio: Xenia and other influences following fertilization.

Robert De C. Ward, Cambridge, Mass.: The war in relation to eugenics—a problem for the United States.

Frederick Adams Woods, Brookline, Mass.: Significant evidence for mental heredity.

Others who expect to present papers are Prof. W. E. Castle, of Harvard; Williams Haynes, Northampton, Mass.; Prof. Albert E. Jenks, of the University of Minnesota. Dr. A. J. Rosanoff, director of the Nassau County (Long Island) survey, will report on that important investigation, if the work of compiling the results is finished by that time.

Other members who desire to present papers should communicate with the secretary at once.

The meetings of the association will be open to the public, as usual.